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Compiled By
CHARLES E. SHAW

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AGRICULTURE AND APPLIED SCIENCE LIBRARY MAY 6 1954

Three New Anoles from Mexico

By WILLIAM B. DAVIS

In the course of biological investigations conducted in the Mexican state of Guerrero by field parties from the Department of Wildlife Management of Texas A. and M. College in the summers of 1952 and 1953, several hundred herpetological specimens have been assembled. Even though the region we worked most thoroughly had been explored previously by many others interested in herpetology, we have been able to fill in many gaps in the knowledge of geographic distribution of snakes and lizards in western Mexico and to collect representatives of three lizards of the genus *Anolis* that seemingly are new to science. Much of our success has been due to the large number of individuals (16) in each party who actively searched for specimens and especially to Ralph W. Axtell, an ardent, discriminating field herpetologist, who has accompanied me to Mexico on each expedition since 1949. Special recognition should be given to Srs. Luis Macias and Bernardo Villa of the Mexican Department of Game who have assisted materially in procuring collecting permits. Dr. Hobart Smith has been especially helpful in this study. It was he who pointed out the uniqueness of the form described below as *A. subocularis*.

Basically, two major groups of anoles are known from Guerrero. One has perfectly smooth ventrals and includes the long-legged forms *A. taylori* from the region near Acapulco, *A. gadovi* from Tierra Colorada, *A. dunni* from the mountains near Agua del Obispo, and *A. liogaster* from the high mountains near Omiltemi, in all of which the tip of the longest hind toe reaches the eye with the hind leg laid forward; and a new species of small, short-legged anole from near Omiltemi in which the tip of the longest toe barely reaches the ear or fails to do so, described below. The other group has keeled ventral scales and includes *A. nebulosus* (with yellow gular fan), *A. megapholidotus* (with red gular fan), and two new species, described below; one with a ruby-red gular fan and the suboculars and supralabials broadly in contact, the other with reddish or orange gular fan and the suboculars and supralabials separated completely or nearly so by a posterior extension of the bottom row of loreals. This last species has been reported in the literature under the name *Anolis nebuloides*, a species that, so far as I can determine, does not occur in Guerrero.

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Anolis omiltemanus sp. nov.

Holotype. TCWC No. 10278, male; collected by Ralph W. Axtell, two miles west of Omiltemi, 7800 feet, Guerrero, June 11, 1953; original No. 432.

Paratypes. TCWC. Nos. 10277 and 10279-81 (two males, two females), collected by Axtell at the same locality on June 11, 1953.

Diagnosis. A small anole with gular fold yellowish or orange; two to four postrostrals between nasals; interparietal usually separated from supraorbital semicircles by one row of small scales. Middorsal scales three to four times the size of laterals, distinctly but weakly carinate; ventrals smooth, rounded, slightly imbricate; two large elongate postanals in males; width of head about two thirds of distance from tip of snout to ear; legs relatively short, length of tibia near 70% of distance from snout to ear (about snout to eye); tip of longest toe to ear (or less) with hind leg laid forward; upperparts grayish tan without a distinct pattern.

Description of type. Head relatively long and narrow (width 68% of length from tip of snout to ear opening); middorsal scales three to four times the size of lateral scales and distinctly, although weakly, keeled; ventrals smooth, rounded, slightly imbricate and larger than dorsals; two large, elongate postanal scales; head scales relatively smooth except for unicarinate canthals and internasals; two postrostrals between nasals; three large supraoculars broadly in contact with supraorbital semicircles; supraorbital semicircles broadly in contact; interparietal larger than ear opening and separated from supraorbital semicircles by one row of scales; three rows of loreals; two gulars in contact with mental between anterior chin shields; five scales across snout between second canthals (from eyes); four canthals (not counting scale below nostril) distinctly, but weakly carinate; tip of longest toe to ear with hind leg laid forward; tail (broken) compressed distally; gular fan yellowish; upperparts grayish tan with two faint wavy, whitish transverse lines, one between forelegs, second about middle of back; whitish streak on upper lip from eye backward on neck to shoulder, bordered above by narrow black line; head dark brown, darker than back; distinct dark interorbital bar; underparts whitish; throat lightly mottled with blackish; chin immaculate; legs and tail with faint cross bars, most distinct on forearm; lower lips with five or six small blackish spots. Snout-vent length, 44 mm.; snout to ear, 12.2 mm.; width of head, 8.3 mm.; length of tibia, 8.8 mm.

Variations. Males have supraoculars in contact with supraorbital semicircles, they are separated by one row of small scales in females; postrostrals between nasals 2, 3 or 4; scales across rostrum between second canthals 4 or 5; loreals in 3 to 5 rows; supralabials to point below middle of eye, 6 or 7; infralabials to same point, 6 or 7; ratio of width of head to distance from snout to ear, 65 to 70; ratio of length to tibia to snout-ear distance, 68 to 73; color pattern obliterated in some specimens, but all have two black spots at base of tail above.

Comparisons. Differs from *dunni* mainly in smaller size, absence of bold dorsal color pattern, short tibia (68 to 70% of snout-ear length rather than 90% or more), and yellowish orange rather than red gular fan in males; differs from *gadovi* in similar manner and, additionally, in two rather than four gular scales in contact with mental between anterior chin shields. Differs from *liogaster* in grayish tan rather than coppery dorsal coloration, smaller size, etc. Differs from *taylori* in two to four

postrostrals rather than six, three to five rows of loreals rather than six, etc. Differs from *utowanae* in having interparietal larger than ear opening rather than smaller and separated from supraorbital semicircles by one row of small scales rather than three or four rows, etc. Differs from *schmidti* mainly in grayish tan dorsal coloration rather than pale yellow; ventral scales flat and much larger than dorsals, rather than protuberent and not distinctly larger than dorsals; loreals in usually three or four rows (one with five), rather than five, etc.

Remarks. This species seems to belong to the *gadovi* group, but differs markedly in having short tibia. Both *gadovi* and *dunni* have long hind legs, the ratio of tibia to snout-ear measurement averaging well over 100 in *gadovi* and over 90 in *dunni*. In *omiltemanus* this ratio is 68 to 73.

Anolis suboccularis sp. nov.*

* In allusion to having the suboculars separated from the supralabials.

Holotype. TCWC No. 8675, male; collected by Ralph W. Axtell, one mile southwest of Tierra Colorada, 900 ft., Guerrero, July 1, 1952; original No. 309.

Paratypes. TCWC 8674, same locality and date as type; TCWC 9681, 30 km. N Acapulco, 1000 ft.; UIMNH 20132, Rincón; UIMNH 20128, El Limoncito; UIMNH 20119, 2 mi. S. Garrapatas; UIMNH 20114-18 and 25969, Tierra Colorada; USNM (Bacon Coll.) 5512-13, 5515-17, 5570, 5626, 5676-90, 5694, 5707, 5709-13, 5715, 5717, 5719-21, 5724-25, 5779-89, 5791-800, 5802-03, 5805-09, 5811-12, 5815-17, 5819, 5893-98, 5926-29, 5934-36, 5939-41, 5943-46, 10063-64, Tierra Colorada.

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Diagnosis. A medium-sized anole with both dorsal and ventral scales keeled, the ventral scales noticeably larger than the dorsals; hind leg relatively long, reaching to eye or beyond when laid forward; males considerably larger than females; ear opening nearly as large as interparietal; suboculars separated from supralabials or *narrowly* in contact; upperparts grayish, mottled with blackish; legs banded.

Description of type. Head relatively long and narrow (width 66% of distance from snout to ear); dorsal scales (18-20 rows) enlarged, carinate, much larger than granular laterals; ventral scales carinate, mucronate, and distinctly larger than dorsals; postanals enlarged; head scales rugose, those on the snout distinctly carinate; four postrostrals between nasals (six scales in contact with rostral dorsally); five canthals (not counting one under nostril), second one from eye largest, all carinate; three large supraoculars, separated from supraorbital semicircles by row of small scales; two pairs of scales in supraorbital semicircles narrowly in contact medially; parietal about the size of ear opening and separated from supraorbital semicircles by two rows of small scales; loreals in five rows, the bottom one extending posteriorly nearly to corner of mouth and separating the supralabials from the suboculars; four gular scales between first pair of chin shields; gular fan probably reddish or orange in life; tip of longest toe reaches eye with hind leg laid forward; length of tibia (measured from bottom of heel to top of knee with tibia and femur at right angles) nearly the distance from tip of snout to ear opening; upperparts grayish, mottled with brownish; tail and legs barred above; under-

parts, including legs, whitish, the chin and throat faintly marbled with gray (punctate under a lens); labials darker than adjacent scale rows, the infralabials with three or four whitish spots; snout less heavily pigmented than cranial section of head. Snout-vent length, 51.7 mm.; snout to ear, 12.5 mm.; width of head, 8.5 mm.; length of tibia, 13.5 mm.

Variations. Ten adult males and ten adult females vary as follows (females in parentheses): snout-vent length, 47-53 mm. (35-46); tip of snout to anterior edge of ear opening, 13-14.5 (10.0-12.0); length of tibia, 12.6-14.9 (10.0-11.4); ratio of length of tibia to snout-ear measurement, 94-102 (93-100); supraorbital semicircles narrowly in contact (one or two pairs of scales) 60%, separated by one row of small scales, 40% (50% and 50%); loreals in 5 rows (50%), in 6 rows (50%) (5 rows, 70%; 6 rows, 30%); one row of scales separating interparietal from semicircles, 20%; two rows, 80% (one row, 20%; two rows, 80%); five canthals, 80%; six canthals, 20% (5, 90%; 6, 10%); four postrostrals, 60%; three postrostrals, 40% (4, 90%; 3, 10%); two gulars in contact with mental between first pair of chin shields, 60%; 3, 30%; 4, 10% (2, 90%; 1, 10%); supralabials and suboculars completely separated by posterior continuation of the lowest row of loreals, 50%, narrowly in contact (one or two separated scales touch), 50% (separated, 80%; narrowly in contact, 20%). The dark dorsal blotches are prominent in some individuals, obscure in others; chin and throat vary from nearly immaculate through mottled to a pattern of medially converging alternate light and dark streaks.

Comparisons. Among anoles with keeled ventrals, this species seems to be unique in having the supralabials and suboculars separated (or nearly so) by a row of scales which is a posterior extension of the first (lowest) row of loreals. Differs from *Anolis nebulosus* (Wiegmann) as indicated above and additionally in much larger ear opening (nearly as large as parietal); larger dorsal and ventral scales; gular fan orange or reddish, rather than yellowish with bluish area an anterior section. Differs from *A. nebuloides* Bocourt as indicated above and in having dorsal scales that are noticeably smaller than the ventrals. Differs from *A. microlepidotus* Davis, as indicated below, in having the dorsal scales enlarged (not nearly the same size as the laterals), in larger size, and in relatively longer tibia. Differs from *Anolis megapholidotus* Smith as indicated above in having the ventrals larger than the dorsals, rather than the reverse, and in relatively longer tibia (more than 90 per cent rather than less than 75 per cent).

Remarks. Some of these specimens have been reported previously in the literature as *Anolis nebuloides* Bocourt. The occurrence of *nebuloides* in Guerrero, however, needs confirmation in the light of current knowledge.

*Anolis microlepidotus** sp. nov.

*In reference to the small dorsal scales.

Holotype. TCWC No. 10276, male; collected by Theron W. McCorcle, four miles west of Chilpancingo, 5800 feet, Guerrero, June 17, 1953; original no. 67.

Paratypes. TCWC No. 10009, female, 4 mi. W Chilpancingo, 5800 ft.; UIMNH No. 20127, female, Chilpancingo.

Diagnosis. A small anole with large, keeled ventrals; small dorsals (not much larger than largest laterals); ruby red gular fan; short hind leg (toe fails to reach ear with leg laid forward); grayish dorsal coloration mottled with blackish and a black or brown V-shaped interorbital bar; 17-18 lamellae under second and third phalanges of fourth toe.

Description of type. Dorsal scales small, slightly larger than laterals, weakly carinate; ventrals much larger than dorsals, carinate and mucronate; postanals moderately enlarged, but not elongated transversely; head scales rugose but not carinate; supraoculars roughly in two rows, three large rounded ones in inner row, one large and one small one in outer row, separated from supraorbital semicircles by one or two rows of smaller scales; interparietal larger than ear opening, separated from supraorbital semicircles by three to four rows of smaller scales; semicircles separated by one row of large scales; frontal ridges beaded, prominent, diverging anteriorly and enclosing conspicuous valley; three postrostrals; six canthals (not counting one under nostril); five rows of loreals, the bottom row reaching posteriorly to sixth supralabial; infraorbitals and supralabials broadly in contact (supralabials 6-8 in contact); two gulars in contact with mental between anterior chin shields; toe to slightly beyond shoulder with hind leg laid forward; tibia about 80 per cent of distance from snout to ear; upper parts grayish with dark (blackish) mottling, two black spots dorsally at base of tail, distinct V-shaped black interorbital bar; legs barred with blackish; gular fans ruby red; underparts whitish mottled with blackish on throat and hind legs; distinct black stripe from eye onto neck above ear; supralabials and suboculars white save for black spot directly below eye and faint stippling on other scales; 17 lamellae under second and third phalanges of fourth toe; snout-vent length, 38.8 mm.; width of head, 6.5; tibia, 8.3; snout to ear, 10.5.

Variations in paratypes. Three large supraoculars in a single series, rather than five in two rows; supraorbital semicircles in contact (not separated by median row of scales); interparietal separated from semicircles by one or two rows of scales rather than three or four; frontal ridges less prominent; four rows of loreals in one, five in the other, the bottom row extending posteriorly to middle of fifth supralabial; dark dorsal markings less intense and less extensive; tibia 9.0-9.5 mm.; snout to ear, 11.7 mm. in both. Agree with the type in all diagnostic characters listed under *Diagnosis* above.

Comparisons. Among anoles with keeled ventral scales, this species seems to be closest to *A lemurinus bourgeaei* Bocourt from the eastern coast of Mexico and Guatemala (based on descriptions), but it differs in having enlarged postanals in males, scales on snout rugose rather than keeled, scales on rest of head (except supraoculars) rugose rather than smooth, and tail slightly compressed rather than cylindrical. Differs from *A. nebulosus* in several characters, but most conspicuously in ruby red gular fan rather than yellowish with purplish spot in anterior section; dorsal scales slightly larger than laterals rather than conspicuously larger; ear opening larger; 17 lamellae under second and third phalanges of fourth toe rather than 20-23. For comparisons with *A. subocularis* see account of same. Differs from *A. nebuloides* in smaller size, much smaller dorsal scales, relatively smaller ear, relatively shorter tibia, etc.

Diagnostic Key to the Anoles of Guerrero

1. Ventrals perfectly smooth 2
   Ventrals distinctly keeled 6
2. Hind leg short, hind toe to ear or less; ratio of length of tibia to snout-ear measurement 68 to 73; gular fan yellowish-orange ..... *omiltemanus*
   Hind leg long, hind toe to eye or nearly so; ratio of length of tibia to snout-ear measurement 82 to 103; gular fan reddish 3
3. Upper parts coppery or reddish brown; ratio of tibia to snout-ear measurement about 82; dorsum with usually irregularly outlined vertebral stripe ..... *liogaster*
   Upperparts gray, marked with black; ratio of tibia to snout-ear measurement more than 90; no vertebral stripe (except in some females of *dunni*) 4
4. Four (rarely three) gular scales in contact with mental between anterior chin shields; size large (snout-vent length to 80 mm.) ..... *gadovi*
   Two gular scales in contact with mental between anterior chin shields; size smaller; distinct white stripe under eye 5
5. Seven or eight scales between nasals; six scales in contact with rostral between supralabials; five or six rows of loreals ..... *taylori*
   Six scales between nasals; five scales in contact with rostral; four rows of loreals ..... *dunni*
6. Dorsal scales as large as or larger than ventrals; males with dark brown dorsolateral stripe ..... *megapholidotus*
   Dorsal scales distinctly smaller than ventrals 7
7. Suboculars and supralabials completely separated or nearly so by posterior extension of lowest row of loreals; gular fan ruby red ..... *suboculars*
   Suboculars and supralabials broadly in contact 8
8. Gular fan yellow with bluish or purplish spot in anterior "corner"; ear opening minute; general color yellowish or light tan; females often with cream colored vertebral stripe ..... *nebulosus*
   Gular fan ruby red; ear opening larger but smaller than interparietal; general color grayish with blackish mottling and distinct V-shaped interorbital bar ..... *microlepidotus*

DEPARTMENT OF WILDLIFE MANAGEMENT, AGRICULTURAL AND MECHANICAL COLLEGE OF TEXAS, COLLEGE STATION, TEXAS

A RECORD OF THE ATLANTIC LEATHERBACK TURTLE (*DERMOCHELYS C. CORIACEA*) IN SOUTH CAROLINA. — Although the Atlantic leatherback turtle (*Dermochelys c. coriacea*) is widespread along the eastern seaboard and ranges from the coast of Nova Scotia south to Argentina (*fide* Carr, Handbook of Turtles, 1952, p. 442), there appears to be only one published record for the coast of South Carolina (de Sola and Abrams; Copeia, 1933, p. 12). This fact, coupled with the general paucity of available data on these huge chelonians, prompts the recording of the following information.

A moderate-sized female leatherback turtle was taken October 7, 1952, by Dunks McClellan off Bull's Bay (latitude 33° north, longitude 79° 30′ west), South Carolina. McClellan was shrimping at about 5:00 PM in water 25 to 30 feet deep and the turtle became entangled in the net. The reptile was taken to shore and brought to the attention of Paul W. Sturm, refuge manager of the Cape Romaine National Wildlife Refuge, who in turn caused it to be brought by truck to The Charleston Museum. There the following data were taken while the animal was yet alive; after death a skeleton (ChM 52.90) was made of the reptile.

All measurements were taken with a flexible steel tape. The greatest length of the carapace, measured over its curvature, was 61″; the plastron measured 43½″ in length and 37¾″ in greatest width. The tail measured 18¼″ from the posterior margin of the plastron to its tip, the anus being situated 14″ behind the posterior edge of the plastron. The greatest depth of the turtle, through its anterior third, was 15½″. The weight of the animal was 680 pounds, which is somewhat less than the weight of the smallest individual given by Carr (*op. cit.*, p. 446). Preparation of the skeleton revealed that the animal was indeed immature; the cervical vertebrae were incompletely ossified.

The coloration was noted in some detail. The carapace was slate gray—almost black—with the ridges having a few elongate whitish spots. The most lateral of the dorsal inter-ridge troughs had many scattered white spots. Such spots occurred in lesser numbers in the more central troughs. Ventrally, the plastron was generally a combination of slate color and pink, the latter due to the suffusion of blood beneath the otherwise white skin. The lateral margins of the carapace were clearly defined, when viewed ventrolaterally, by an irregular series of white blotches which were set off from the more or less uniformly slate-colored bridge. A second series of white blotches occurred longitudinally along the center of the bridge. The plastron itself was much blotched with white. Dorsally, the head was almost black except for a white spot behind and between the eyes. The cheeks, upper lips, and rostrum were flecked or striped with white; the entire throat was closely spotted with white on a slate background. The upper surface of all the appendages was black with scattered rosettes of grayish, concentrated on the anterior margin of the forelimbs. The skin of the ventral proximal portion of the forelimb was white, and that of the plantar surface of the hindfoot was much blotched with white rosettes about ½″ in diameter. — ALBERT SCHWARTZ, the Charleston Museum, Charleston, S. C.

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INTERESTING BREEDING DATES FOR SOME SOUTH CAROLINA FROGS.—On the night of March 13, 1953, two calling male *Hyla v. versicolor* (Le Conte) were collected in a flooded gum bottom situated in mixed woods, 15.1 mi. NW of Charleston, Dorchester County, South Carolina. Wright and Wright (Handbook of frogs and toads, 1949, p. 346) state that "these tree toads breed from the end of April to Aug. 11." Carr (A contribution to the herpetology of Florida, Univ. Fla. Publ., Biol. Sci. Ser., 3 [1], 1940, p. 62) gives the earliest breeding date in Florida as April 11. The following evening, March 14, additional *H. v. versicolor* were heard, but none was collected.

An adult female in breeding condition was taken March 23, 1953, at a locality 6 mi. SW, 1.5 mi. NW of Summerville, Dorchester County, South Carolina, in the immediate vicinity of another gum pond, in which eleven males were collected. This series is now deposited in The Charleston Museum (ChM 53.69.3) together with the two males of March 13 (ChM 53.62.2).

Along with the March 13 series of *versicolor,* a calling male *Pseudacris ornata* (Holbrook) was also taken. Carr's *(op. cit.,* p. 58) latest breeding date for this species is March 2.

Associated species calling at these localities were *Scaphiopus h. holbrooki* (Harlan) (March 11, 1953), *Rana pipiens* Schreber (March 13, 1953), and *Rana clamitans* Latreille (March 13, 1953).

Temperature, humidity, and precipitation were recorded by the Charleston Weather Bureau as follows:

Rainfall		Temperature		Humidity	
March 11	1.59″	March 13		March 13	
March 12	.05″	High	74°	7:00 A.M.	100%
March 13	1.00″	Low	58°	12:00 Noon	69%
March 22	.42″	Mean	66°	7:00 P.M.	90%
March 23	.80″				

Thanks are due to Dr. Albert Schwartz and Julian Harrison for accompanying me in the field.—John A. Quinby, The Charleston Museum, Charleston, S. C.

A New Plethodontid Salamander from Southwestern Virginia

By WALTER B. NEWMAN

Netting, Green, and Richmond (1946) were the first to record *Plethodon wehrlei* Fowler and Dunn from Virginia and list three localities for the state: Blacksburg, Dixie Caverns near Salem, and a point on the Virginia-West Virginia border where U. S. Highway #250 crosses this boundary. Since the publication of that paper Pope and Fowler (1949) have found sufficient evidence to describe the Dixie Caverns population as a new form of *Plethodon,* namely *Plethodon dixi.* I have studied the form that occurs around Blacksburg for a number of years and have found it to be different from both *P. wehrlei* and *P. dixi.*

Dr. Herbert W. Jackson, formerly Associate Professor of Biology at Virginia Polytechnic Institute, has collected extensively in southwestern Virginia and was definitely instrumental in bringing the attention of various herpetologists to the presence of *wehrlei*-like *Plethodons* in Virginia. Dr. Jackson is a constant source of encouragement and inspiration to many aspiring naturalists and it is with great pleasure that I call this new species:

Plethodon jacksoni sp. nov.

Diagnosis. A member of the Glutinosus Group (Grobman, 1944), similar in structure and general appearance to *P. wehrlei* and *P. dixi.* It differs from these two forms in the following respects: presence of red spotting on the dorsum of adults; very distinct mental gland present in sexually mature males; hedonic swelling above the base of the tail in sexually mature males; color and distribution of the light and dark areas of the ventrum.

Holotype. WBN (personal collection of author) 6, an adult male from Trillium Vale, elevation 2,100 feet, approximately one mile east of Blacksburg, Montgomery County, Virginia, collected by Walter B. Newman on February 11, 1950.

Paratypes. All collected by Walter B. Newman. Seventeen topotypes were collected in Trillium Vale on the following dates: WBN 2-4, January 25, 1950; WBN 1, February 11, 1950; WBN 96, 107-8, 124-5, February 15, 1950; WBN 1250, February 19, 1951; WBN 1350-2, April 15, 1951; WBN 1295-8, April 19, 1951.

Eight paratypes, WBN 453-6, 673-6, were collected May 27, 1950, in Old Mill Cave, elevation 1,600 feet, located at the edge of Mill Creek, approximately 100 yards north of its junction with the North Fork of the Roanoke River at Bennets Mill, situated on State Route #114. Three paratypes were collected in a very small cave in the Virginia Polytechnic Institute Ecology Area, elevation 1,900 feet, on the following dates: WBN 1519, February 19, 1951: WBN 1294-5, March 7, 1951. This last station is adjacent to Trillium Vale. All records are from Montgomery County, Virginia.

Description of Holotype (all measurements in millimeters). An adult male with the following measurements: total length, 120; tip of snout to anterior angle of vent, 57; greatest width of body, 7.5; greatest height of body, 6; axilla to groin, 31; greatest width of tail, 4.5; greatest height of tail, 5.1; tip of snout to gular fold, 13.8; tip of snout to anterior

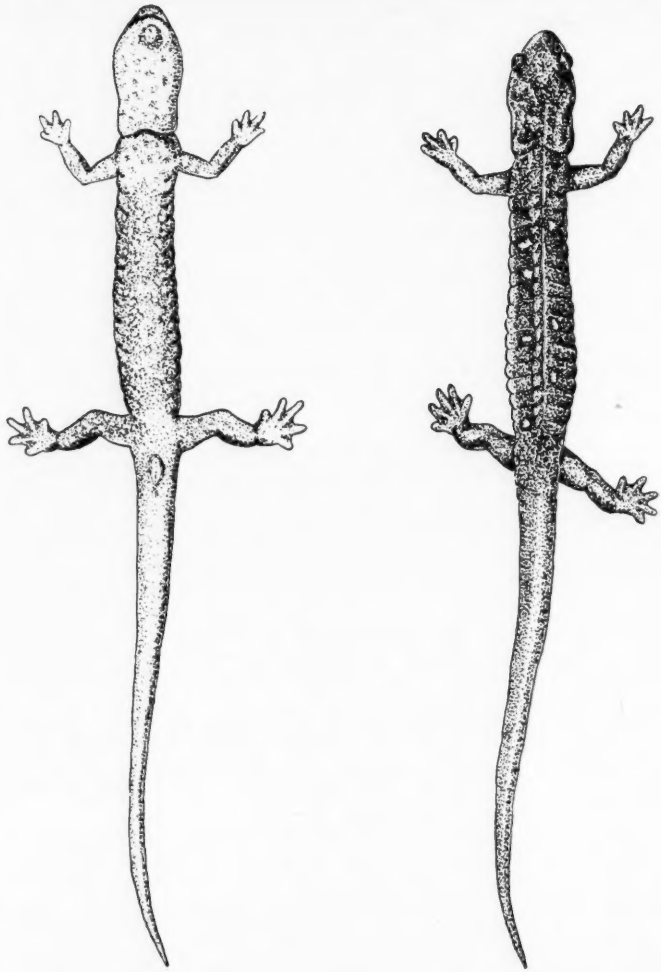

FIG. 1. Ventral and dorsal aspect of *Plethodon jacksoni*, sp. nov., type specimen. Total length, 120 mm.

insertion of forelimb, 16.1; greatest width of head, 8; eye, measured from anterior to posterior corners, 2.2; forelimb, measured from insertion of limb to tip of longest toe, 11.5; hindlimb, similarly measured, 14.

Body and tail, slender and well rounded; head broadly oval in outline when viewed from above, widest immediately posterior to the eyes; snout bluntly pointed and depressed; eyes prominent; mental gland evident; noticeable swellings projecting downward below each naris; vent slightly protuberant; costal grooves, 17-17, counting one each in the axilla and groin; intercostal grooves, 4-4; vomerine teeth, 6-7; parasphenoid teeth in two slender patches, separated from the vomers by approximately the diameter of a naris, becoming slightly wider posteriorly.

The color (after preservation in formalin) above is a deep brownish-black, becoming slightly more brownish on the head and posterior portion of the tail. Four distinct, and one small, indistinct, yellow-white spots (orange-red in life) are present on the left side of the mid-dorsal line and three distinct spots are present on the right. Light flecks are rather evenly distributed on the head and back, becoming less evident on the posterior portion of the tail. The cheeks and lower sides are profusely blotched with irregular light areas, with the surrounding dark pigment being a shade lighter than the dorsal ground color. This lateral marking is continuous along the sides to a point opposite the posterior angle of the vent, where it stops rather abruptly; it encroaches ventrally to the outer edge of the belly. The chest and throat are light and very lightly mottled with grey; belly, slightly more greyish with a few well-separated light areas. The lower surfaces of the limbs are mottled like the lower sides.

Size. Sixteen adult males vary in total length from 69 mm. to 135 mm. (mean 116.1). Five adult females have extremes of 113 mm. and 133 mm. (mean 124.6). The smallest individual found has a snout-vent length of 17 mm. and a total length of 27 mm.; the largest, a male, has a snout-vent length of 62 mm. and a total length of 135 mm. *P. jacksoni* is apparently intermediate in size between *wehrlei* and *dixi:* the maximum total length of *jacksoni* is 135 mm., whereas the corresponding measurements for *wehrlei* and *dixi* are 152 mm. (Bishop, 1943: 281) and 124 mm. (Pope and Fowler, 1949: 3) respectively.

Variation. Extremes in the costal groove counts of twenty-eight adult *jacksoni* are 15 and 18, with the usual number being 16 (11 specimens) or 17 (14 specimens); intercostal groove counts are 3 (12 specimens) and 4 (16 specimens). Vomerine tooth counts (total of right and left series) range from 9 to 15 (mean 12.8).

Sexual dimorphism. Adult males may be distinguished by the presence of prominent mental glands and swollen protuberances extending below each naris. Large males frequently exhibit a hedonic swelling above the base of the tail. Females appear to have a longer body, with every adult female exhibiting 4 intercostal grooves, while only 47.4% of the males have 4 and 42.6% have 3 intercostal grooves. No noticeable difference in the tooth counts was found between the sexes.

Color. Color notes taken from living *jacksoni* are as follows: "belly ground color, deep slaty-blue, very similar to *P. glutinosus;* moderate to heavy white blotches on the lower third of the sides and encroaching upon the belly fully or, more commonly, leaving a wide mid-ventral dark area; under surface of tail slaty-blue. Chest usually light with a few dark areas;

throat lighter than belly, often mottled with small light areas. Dorsum deep bluish-black, with moderate to profuse white flecks; moderate to profuse silvery mottling present on back and tail, usually faint or lacking on head; orange-red spots on back, faint to conspicuous and variable in number. Limbs marked like lower sides." The dorsal orange-red spotting becomes yellowish-white in preservative and is sometimes barely perceptible in preserved material. The silvery mottling will generally disappear within twenty-four hours, but the white flecks remain fairly evident after a period of years. It is interesting to note that the belly ground color, although similar to that of *glutinosus,* does not persist in preservative. Within a matter of weeks, this deep slaty-blue fades to a very light grey, giving this salamander an entirely different appearance.

In occasional specimens, the light markings of the sides, as mentioned in the field notes, encroach fully upon the belly, giving it a heavily mottled effect as in *dixi,* or comes only to the outer margins, as in *wehrlei.* This variation is found in only a few specimens and so far cannot be correlated with the few adults lacking the red spotting.

The throat and chest are extremely variable in the amount of light and dark areas. Some individuals have very sparse markings, while others are heavily mottled. A number of specimens have a light throat and a mottled chest, whereas others have a mottled throat and light chest. Again, there is no indication that there is any correlation between these markings and the sex or dorsal spotting.

Habitat. In Trillium Vale *jacksoni* is most commonly found under rocks and logs that are slightly embedded in the soil. This salamander also shows a decided preference for the drier upper third of the hillsides. Although *cinereus* and *glutinosus* are found frequently in the same area and under the same type of cover, they are only rarely found with *jacksoni.* Specimens from Old Mill Cave were found beyond the twilight zone and were quite active when disturbed. This species, as well as *E. l. longicauda,* was found on the walls and numerous formations in the main room of the cave. Other vertebrates inhabiting this cave are Pickerel Frogs (*Rana palustris*), Georgian Bats (*Pipistrellus s. subflavus*), Cave Rats (*Neotoma m. magister*), and certain unidentified small fish that were common in the stream.

Plethodon jacksoni has been collected from caves in February, March, May, June, July, and October. It has been found outside of caves in January, February, and April. The specimens collected outside are identical with the subterranean form and I believe that these differing habitats are the result of certain restricted populations making use of the limited ecological niches available, and are not the result of periodic migrations.

Remarks. More detailed information concerning the habits, habitats, ecology, etc., of *P. jacksoni* will be presented in a survey of Montgomery County, Virginia, amphibians to be published in the near future.

Discussion. Netting, Green, and Richmond (1946), and Fowler (letter, April 6, 1951), report collecting *wehrlei* from Highland County, Virginia. Grobman (1949: 136) has recorded a specimen from Nelson County, Virginia, as being *wehrlei.* These records locate *wehrlei* in the Appalachian Plateaus and the Blue Ridge in this state. The two stations are widely separated by the Valley and Ridge, but *P. dixi* and *P. jacksoni* are found in this physiographic province to the south. This establishes

the presence of a *wehrlei*-like *Plethodon* in each of the three major physiographic provinces (Fenneman, 1938) in the western portion of Virginia.

Several specimens loaned to me by R. L. Hoffman have proven to be extremely interesting. One is a red spotted *Plethodon* collected by Leslie Hubricht in the Smith Mountain Gorge, Pittsylvania County, Virginia, on October 21, 1950. This specimen closely resembles, and has been tentatively referred to as, *P. jacksoni.* Pittsylvania County is well into the Piedmont and this is probably the first *wehrlei*-like form to be recorded from this physiographic province. Another red spotted individual, also collected by Mr. Hubricht, was found October 22, 1950, in Kibler Park, Patrick County, Virginia. This specimen was identified as *P. yonahlossee,* but because it was a juvenile and well outside the eastern limits of its range as recently delimited by Pope (1950), a trip was made to Kibler Park by R. L. Hoffman and the author to confirm this record. After three or four hours collecting on a very dry day, a single *yonahlossee* was found under a piece of shale on a steep hillside adjacent to a small stream. This specimen, although small (86 mm. in total length), was very typically marked and left no doubt as to its identity. This is a range extension of approximately sixty airline miles and I believe the first record for this species east of the New River in Virginia.

These records indicate that *yonahlossee* extends farther into the northeastern portion of the Blue Ridge than has been formerly suspected, and also that a *wehrlei*-like form is represented in the Appalachian Valley and Ridge, Blue Ridge, and even Piedmont provinces! Although *yonahlossee* is apparently still restricted to the extreme southern portion of the Blue Ridge in Virginia, it is evident that the range of this species and *wehrlei,* or a closely related form, are not so widely separated and could possibly meet or overlap in the virtually unexplored mountainous regions between Roanoke and the Pinnacles of Dan to the south. There is no apparent ecological or physiographical barrier separating the two forms in this section of the Blue Ridge.

Grobman (1944: 276) states, "The relationship, both geographically and morphologically, between *wehrlei* and *yonahlossee* is very close." He supports this theory with comparative information on the size, range, and pigmentation of the two species, based on a north-south gradient. The following summary of more recent information lends weight to this theory: there is (1) a monochromus form, *P. wehrlei,* occupying a range from southern New York southward to a region in extreme eastern West Virginia; (2) a form of *wehrlei* occurring in the northwestern portion of Virginia, and probably the adjacent portion of West Virginia, with red spotting present in the juveniles and lacking in adults; (3) *P. jacksoni,* found in the Valley and Ridge, with red spots present in the adults and juveniles; (4) *P. yonahlossee,* with red spots in the juveniles and a chestnut band in adults, found in the extreme southern portion of the Blue Ridge in Virginia; and (5) a red-spotted *Plethodon,* remarkably similar to *jacksoni,* found in the Piedmont, almost due east of the Patrick County *yonahlossee* record.

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It is clear that *yonahlossee, wehrlei,* and *jacksoni* are closely, if not subspecifically related. Undoubtedly *dixi,* although lacking any red spotting, falls into this same classification. Further work, especially in the

Blue Ridge portion of Virginia, is needed to establish more clearly the relationships between these *Plethodons*.

Range. The exact range of *P. jacksoni* is not known. Besides the Montgomery County records, there are some specimens reportedly collected from caves in Giles and Craig Counties in Virginia. The Pittsylvania County record is intriguing, but a good series of specimens is needed from there before the population can be identified with any degree of certainty.

Acknowledgements. I am deeply indebted to Mr. Charles M. Bogert, of the American Museum of Natural History, and Dr. Doris M. Cochran, of the United States National Museum, for kindly allowing me to examine records and material. Dr. I. D. Wilson and Dr. Herbert W. Jackson, of Virginia Polytechnic Institute, generously allowed me the almost unlimited use of the laboratory and equipment in the Department of Biology at that institution. Mr. James A. Fowler, of the Academy of Natural Sciences of Philadelphia, has read the entire manuscript and helpfully provided comments and records. Mr. Richard L. Hoffman has proferred many helpful suggestions and aided in other ways too numerous to mention. Mr. William E. Ellis has been an excellent field companion and of invaluable aid in the laboratory. My wife, Jaine, has been of invaluable aid in the preparation of the manuscript. To all of these people I am deeply grateful.

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5726 CHILLUM HEIGHTS DRIVE, HYATTSVILLE, MARYLAND

Eggs and Egg-laying of *Lampropeltis c. calligaster* (Harlan)

By ROBERT F. CLARKE

There are few published descriptions of the actual egg-laying process of snakes. An opportunity to observe the deposition of eggs was afforded by a female blotched king snake (now H-674 at KSTC, Emporia), *Lampropeltis c. calligaster* (Harlan), captured June 27, 1953, by the author one mile west of Melvern, Osage County, Kansas. Its body length was 860 mm., the total length 994 mm. On July 15, nine eggs were laid. The following account of the egg-laying is taken from notes made at that time.

9:00 A.M.—When observations were started, six eggs had already been deposited, three others could be seen as bulges in the body. The female was lying in a circular position with her head beneath the loose pile of eggs. The tail was raised and was lying on top of the pile of eggs.

9:10 A.M.—The position of the snake was unchanged. One of the unlaid eggs had moved nearer to the anal opening.

9:12 A.M.—Periodic contractions were occurring in the anal region. These were short spasms in which the tail, slightly arched, was raised and lowered a little. The egg moved only slightly during each contraction. The anal plate was pushed down and the opening to the cloaca was enlarged.

9:16 A.M.—The contractions were still occurring. The tip of the egg was now visible.

9:17 A.M.—The egg was extruded, except for the tip. No movement was noted as the egg emerged. The tail seemed to slide over to the left as the egg was laid.

9:26 A.M.—Two eggs were still within the body, and the next egg had not yet approached the anus. The body was tightly compressed now, and both the sides and top of the vertebral column stood out in sharp relief for a distance of about five inches anterior to the last egg contained in the body.

9:50 A.M.—The next egg had moved into position and the anal plate had extended. The same muscular contractions as described before had taken place for two minutes. The periods between contractions were timed and found to have no set pattern. Some periods were of only three seconds duration, whereas others were as much as fifteen or twenty seconds in duration.

9:52 A.M.—The egg was now out. Still the female had not changed position. The only movements observed so far were the contractions just before the egg was extruded. The tail did not seem to move into position for the next egg voluntarily; the emergence of the egg forced the tail to one side or the other, and there the next egg was deposited.

10:44 A.M.—The last egg had moved into position and the contractions had begun.

10:52 A.M.—The tail was raised slightly and the contractions were rhythmic, but irregular in intensity.

10:53 A.M.—The tip of the egg was visible.

10:54 A.M.—The egg began to emerge.

10:56 A.M.—The egg had emerged, except for the tip. The tail was lying on top of the egg.

10:58 A.M.—The tail was still on top of the egg, but the egg was free of the body.

11:00 A.M.—The eggs were removed from the cage without moving or disturbing the snake.

4:00 P.M.—The female was still in the same position with the head buried beneath the dirt, although five hours had elapsed since the last egg was laid.

The eggs were ellipsoidal, white and smooth, except for several irregularities due to uneveness of shell thickness. They adhered to each other. Two measurements were taken of the diameter of each egg. The larger of the two diameters was taken 10 mm. in from the larger end; the other diameter 10 mm. in from the smaller end. Weights and measurements were determined within fifteen minutes after deposition of the final egg.

The weights varied from 10.9 to 12.4 g., av. 11.6; one diameter from 18.5 mm. to 20.0 mm., av. 19.3 mm., the other from 16.0 mm. to 19.5 mm., av. 18.0 mm.; the lengths varied from 41.0 mm. to 48.5 mm., av. 44.1 mm.

KANSAS STATE TEACHERS COLLEGE, EMPORIA, KANSAS

A NEGATIVE NOTE ON ANTIBIOTICS.—The observation that frequently small pools of standing water do not stagnate readily if a salamander is present in the pool, has led to the suggestion that possibly an antibiotic substance could be found in the skin of Caudates.

This suggestion was tested by several experiments. Two specimens of each of three different salamander species (*Triturus viridescens, Necturus maculosus, Ambystoma tigrinum*) were retained in covered containers of water which had been previously seeded with three kinds of bacteria (*Sarcina lutea, Serratia marescens, Escherichia coli*). Plate counts were made from top, middle, and bottom areas of the water mass daily for four days, but showed no significant differences from controls that could not be traced to gill action, pH change, or fecal bacteria from the animals.

Skin fragments from various areas of the animal's bodies were then centered on agar plates radially streaked with six kinds of bacteria, namely, Micrococcus aureus, Seratia marcescens, Escherichia coli, Bacillus subtilis, Aerobacter aerogenes, Sarcina lutea. Blood and coelomic fluids were also centered, as above, by soaking in paper discs. The plates showed no results that could support the presence of an antibiotic substance.—Joseph C. Daniel, Jr., and Robert W. Simpson, Adam's State College, Alamosa, Colorado.

A New Species of *Chersodromus* from Mexico

By Richard G. Zweifel

As presently defined, the genus *Chersodromus* is monotypic, including only the single species *C. liebmanni* Reinhardt, found in central Veracruz, Mexico. Included in a large collection of reptiles obtained from W. W. Brown of Chilpancingo, Guerrero, is a single specimen of an evidently undescribed species of snake. It is proposed that this snake be named

Chersodromus annulatus sp. nov.

Type. Male, No. 45030, Museum of Vertebrate Zoology, collected by W. W. Brown near Chilpancingo, Guerrero, Mexico, between August 1942 and August 1943.

Description of type specimen. Snout-vent length 370 mm., tail length 77 mm.; width of head 12 mm., length of head 18 mm.

Ventral scales 140, subcaudals 41, anal single; supralabials 6-6; infralabials 7-7, the first pair meeting on the midline behind the mental; two pairs of enlarged chinshields, anterior twice the length of posterior, the

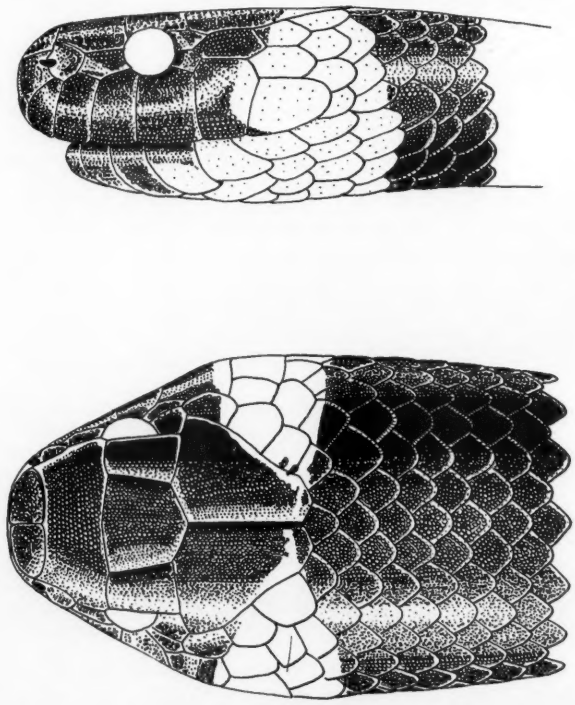

Fig. 1 *Chersodromus annulatus* ssp. nov., type specimen, MVZ 45030, dorsal and lateral views of head.

latter separated on the midline by a single scale; no preocular; prefrontals fused, forming a single scale, reaching the eye as does the loreal; postoculars 2-2, no fusion of postoculars with supraoculars; temporals 1+2; dorsal scale rows 17-17-17, scales finely striated and keeled beginning about one head length back of the head, but excluding the three lowest rows on each side which are smooth; no scale pits discernable.

Body black with eight light rings complete ventrally, the first commencing 14 scales back of the parietals. Each ring is 3-4 scales wide dorsally, broadening to include 3-5 ventrals. Dark interspaces are 3-4 times the width of the light rings. Due to discoloration in preservative, the original color of the light rings cannot be determined. There are three light rings on the tail. A light ring on the head is narrowly incomplete at the tip of the parietals, widening from this point to include part or all of the last two supralabials and the last four infralabials, and includes most of the chin (Fig. 1).

Material. The holotype has been the only specimen of *Chersodromus annulatus* examined. Through the courtesy of Dr. Doris M. Cochran, six specimens of *C. liebmanni* from the Cuautlapan, Veracruz, in the collection of the United States National Museum have been available for comparison. L

Diagnosis. C. annulatus differs most conspicuously from *C. liebmanni* in body pattern, the latter species being unicolor black dorsally. In *C. liebmanni,* the postocular is usually fused with the supraocular (on one or both sides in 14 of the 20 specimens, Smith 1943: 402), while the single specimen of *C. annulatus* possesses two separate postoculars on each side.

Generic affinity. The monotypic genus *Schmidtophis* has recently been described to accommodate the species *S. rubriventris,* known from a single specimen from San Luis Potosi (Taylor 1949: 192). According to Taylor, *Schmidtophis* and *Chersodromus* are related. *C. annulatus* shares many characters with both genera.

Taylor *(op. cit.:* 194) lists as the chief generic characters differentiating *Schmidtophis* from *Chersodromus* (1) smooth instead of finely striated scales, (2) absence of an anterior temporal, (3) smaller series of maxillary teeth, decreasing in size posteriorly, (4) reduction of scale rows from 17 to 15 and (5) supraoculars and postoculars separate rather than fused.

Chersodromus annulatus resembles *C. liebmanni* in all characters listed above except the last, a character in which *C. liebmanni* shows some inconsistency. With respect to maxillary teeth, *C. annulatus* has at least six, but injury to the mouth of the specimen prevents an accurate count. Maxillary tooth counts made on six specimens of *C. liebmanni* gave nine maxillae with six teeth and three with seven. This is at variance with the count of "about ten" given by Boulenger (1893: 295). *Schmidtophis* has "six teeth with places for two or three more" (Taylor, *loc. cit.)*

If the species herein described is to be included in the genus *Chersodromus* as proposed, it will be necessary to expand the definition of that genus to include species both with and without supraocular-postocular fusion.

Since *Chersodromus annulatus* is known from only one specimen, the possibility exists that the fusion of prefrontal scales may merely be an individual abnormality. Had this specimen two prefrontals, it would probably be referred to the genus *Geophis.* If it is keyed out as a *Geophis*

in Smith and Taylor (1945), it keys down to *G. omiltemana,* a geographically reasonable conclusion. However, *C. annulatus* differs from *G. omiltemana* both in color pattern and in scalation. *Geophis omiltemana* possesses numerous light crossbands and a light venter, while *C. annulatus* has fewer light rings complete across the otherwise dark venter. *Chersodromus annulatus* has several rows of weakly keeled scales, while in *G. omiltemana* "only the two middle ones show a faint carination" (Gunther, 1885-1902: 92). *Chersodromus annulatus* does not seem to be an aberrant individual of any described species of *Geophis.*

Another snake which bears some resemblance to *C. annulatus* is *Geatractus tecpanecus* Duges, known only from Tecpan de Galeana, Guerrero. As illustrated by Smith and Necker (1943: plate 4, fig. 3), there is considerable similarity to *C. annulatus* in both form and coloration of the head. Nevertheless, there are numerous differences between the two forms which render them distinct. The color pattern of the body of *Geatractus* consists of 10 light bars about one and one half scales wide, which do not reach the venter; that of *C. annulatus* consists of eight light rings three to four scales wide which are complete across the venter. Scale rows are 15-15-15 in *Geatractus,* 17-17-17 in *C. annulatus.* The atypical apical scale pits seen in *Geatractus* (Smith and Necker, *op. cit.* 194) are not found in *C. annulatus,* nor is there any mention made by these authors of striations on the dorsal scales, such as are found in *Chersodromus liebmanni* and *C. annulatus.* Finally, *Geatractus* possesses typical paired prefrontal scales.

It is not expected that the generic assignment of the species herein described is final. The numerous genera of small, burrowing neotropical snakes are in need of a general revision in order to evaluate their validity and to clarify their relationships to one another.

The author is indebted to Dr. Robert C. Stebbins, Dr. Hobart M. Smith and Dr. Edward H. Taylor for advice pertaining to the preparation of this paper.

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MUSEUM OF VERTEBATE ZOOLOGY,
UNIVERSITY OF CALIFORNIA, BERKELEY

A BRIEF OBSERVATION ON MALE COMBAT IN CLEMMYS INSCULPTA.—While preparing to change the water in the turtle pool of a large concrete enclosure wherein was housed a variety of turtles, two adult male specimens of *Clemmys insculpta* were observed behaving rather antagonistically towards each other. This particular activity had not been observed previously by me. Replacement of the water (formerly at 70° F.) with fresh water at a temperature of 82° F. appeared to act as a stimulus to the animals.

Both specimens were males of approximately the same proportions. In combat both animals raised themselves rather high by extending the forelegs. A would bite at B and B would quickly draw his head into the shell and reappear immediately to bite at A who would retaliate in kind. This procedure was followed for some time, with both turtles holding their ground. At one time A appeared to become infuriated by this stalemate and then proceeded to force his adversary back by a series of successive bites at the head of B. It then appeared that B had lost to the aggressiveness of A. This sudden advance by A only served to hold off B temporarily, however, for he then halted his retreat and proceeded to force A backwards with a series of similar bites.

At no time during the observation did any one turtle succeed in inflicting a wound upon the head of the other. This action on the part of the two males continued for approximately three-quarters of an hour, by the end of which time neither specimen showed willingness to part, although A appeared at times to be the more aggressive. I then removed B from the scene and replaced him first with another male of approximately the same size. A refused to show any interest in the newcomer and proceeded to crawl away. I then replaced B and immediately A showed his old fighting spirit as the combat again resumed. I again removed B and replaced him with a female of the same size. A refused to show any interest. Picking up A in one hand and B in the other I brought the two closer together whereupon they began to snap at each other with complete disregard for me. Upon placing both specimens in deep water (previous action took place on land) they formed small "whirlpools" from their very enthusiastic efforts to bite each other. At times A would proceed to give vent to a burst of ferocity and chase B about the pool (approximately 15 feet in length) only to have B reverse himself and chase A. The combat continued at least until two hours had passed, when my observations terminated.—ALFRED DINKINS, San Antonio Zoological Society, San Antonio 12, Texas.

The Status and Origin of the Geckos of the Genus *Sphaerodactylus* on the Pacific Slope of the Isthmus of Tehuantepec, Mexico

By HOBART M. SMITH and THOMAS MACDOUGALL

In scarcely any region of Mexico are the local details of distribution of plants and animals more difficult to assay accurately than in the Isthmus of Tehuantepec. The name "Tehuantepec" has been used for hundreds of years in ambiguous reference to (a) the entire region of the Isthmus (including both Atlantic and Pacific slopes) or to (b) the Pacific slopes of the Isthmus, or to (c) a radius of some 20 miles about Tehuantepec City, or to (d) Tehuantepec City itself. This ambiguity extends to data on amphibian and reptilian distribution. Yet exact range and habitat are of importance since the physiography and thus zoogeography of the Isthmus are so highly complex. A number of works, notably that of Hartweg and Oliver (1940) have clarified the habitat and local range of most herptile species occurring within a radius of about 20 miles from Tehuantepec City, but the exact habitats of many species cited there, as well as others not secured by these authors, remain unknown.

At all times of exploration of the Isthmus, one factor has simultaneously speeded and limited growth of knowledge. That factor is the position of Tehuantepec City as a center of culture and communication over a wide radius for the Zapotec, Chontal, Huave, southern Mixe, and Zoque (of Oaxaca) tribes. Indians who are residents of or frequent visitors to Tehuantepec City often travel (mostly on foot) 50 miles or more to the west, much less to the north and east. Modern bus service has somewhat increased travel range and ease of travel, but as yet no appreciable effect upon reptile collecting by natives has resulted. Collectors stationing themselves in Tehuantepec City can thus receive, by maintaining contact with local talent, material from a vast range of habitats, both distant and near. Although this situation is highly desirable for thorough sampling, it usually makes impossible a precise determination of the derivation of any given specimen.

One of the distributional problems in the Pacific Tehuantepec area is the exact range of the lizard originally described and named as *Sphaerodactylus torquatus* by Strauch. In spite of the fact that some 40 specimens of this gecko have been reported in the literature, all from "Tehuantepec" or vicinity thereof, the exact area of occurrence and of supposed intergradation with *S. glaucus* Cope has remained obscure. Upon clarification of exact range and habitat obviously hinges a large measure of the conclusive evidence necessary before the taxonomic status of the two forms—whether species or subspecies—can be definitively established. Unfortunately no herpetologist has had extensive personal contact with both forms of *Sphaerodactylus* in this critical area. However the concerted effort over a period of several years by the junior author to secure as much information and as many specimens as possible, personally and by contact with local residents, has yielded sufficient information to require significant modifications of previous interpretations.

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That two color phases do exist in the area is an established fact. One, called *Sphaerodactylus g. glaucus* by Smith (1949: 34), is more or less uniform gray above, with few if any markings. The other, generally regarded as a subspecies of *S. glaucus* (*S. g. torquatus*), is similar in

appearance except for a paired black collar on dorsal and lateral surfaces of neck (*cf.* Taylor, 1947: 307, fig. 2).

There is no question of the correctness of application of Strauch's name *torquatus* to the collared form. That the unicolor populations should be referred to *S. g. glaucus* is, however, open to question, since all specimens of *known* provenance from the immediate environs of Tehuantepec City differ consistently from Atlantic coast specimens that are, unquestionably, *S. g. glaucus* (type locality Mérida, Yucatán). The latter specimens have a complex pattern of dark and light spots on nape, rump, elbows, knees, ankles, and wrists (*cf.* Taylor, 1947: 307, fig. 2).

That the Tehuantepec individuals referred to *S. g. glaucus* by Smith are properly regarded as that form, or even as an intergrade population (as he suggested) between *S. g. glaucus* and *S. g. torquatus,* is questionable for three reasons: (a) all individuals differ from the usual *S. glaucus* in simplicity of pattern, and all variants from the norm tend toward *S. torquatus*; (b) they appear to have a moderately large range, perhaps equal to that of *S. torquatus*; (c) in all areas where this form occurs it is fairly constant in appearance; (d) in certain areas it occurs to the exclusion of any other form of *Sphaerodactylus*; and (e) it has a range quite separate from that of typical *S. glaucus.* Accordingly we regard the individuals occurring in the immediate environs of Tehuantepec as belonging to a distinct form for which Peters' name *S. inornatus* is available. Because of almost certain parapatry with *S. glaucus,* and extensive resemblance to the latter in pattern, habits and habitat, we consider it likely that Peters' form interbreeds freely with *S. glaucus,* intergrading along the line of contact of their respective ranges. The two forms are thus to be regarded as subspecies.

Sphaerodactylus glaucus inornatus Peters

Sphaeriodactylus [*sic*] *inornatus* Peters, Monatsb. Konig. Akad. Wiss. Berlin, 1873: 738.

Sphaerodactylus inornatus Taylor, Univ. Kans. Sci. Bull. 1947, 31 (14): 301-302 (history of name).

Sphaerodactylus glaucus glaucus (part), Smith, Journ. Washington Acad. Sci. 1949, 39 (1): 34 (brief color description).

Type. Berlin Mus. No. 4589, two syntypes from the Uhde collection. Type locality "Mexico," restricted by Smith and Taylor (1950: 53) to Tehuantepec, Oaxaca.

Diagnosis. A race of *Sphaerodactylus glaucus,* characterized by nearly complete or complete absence of all distinct dark or light markings in adult; chiefly arboreal or scansorial; no part of tail pink in life; tip of tail waved in life.

Range. Low Pacific plains westward from the valley of the Río Verde and extending into the valleys of the Tehuantepec and Tequisistlán rivers. No records are available for the immediate vicinity of the big lagoons along the coast. The range extends northward to the center of the Isthmus where intergradation with *S. g. glaucus* is thought to occur.

Locality Records. Actual locality records represented by specimens (quantity given in parentheses) in the Univ. Ill. Mus. Nat. Hist. and by the literature: Tehuantepec City (24), Barrio Santa María (of Tehuantepec) (9), Cerro de Guiengola (Smith, 1949), Cajon de Piedra (Smith, 1949), Juchitán (Smith, 1949), Salina Cruz (Smith and Taylor, 1950: 53), Guie-shaya (2000 ft.) on Cerro de Mixtequilla (2), Jalapa (1),

between El Morro and Guelaguichi (2), and San Antonio (2). Others positively identified as this form were seen but not collected at Río Costoche, 3000 ft. (between Las Vacas [Limón] on the Pan-American highway and Santa María Ecatepec), Nejapa, Tequisistlán, Escurano, Ocotito and Mixtequilla.

Specimens Examined. Available at the present time are 40 specimens, and at least 30 others have previously been examined critically. The race is much more common than these figures may indicate. Specimens could readily be secured by the hundreds. These have been compared with 63 *S. g. glaucus* now at hand (from Yucatán, Tabasco and Veracruz), and with some 35 other specimens not now available but critically examined at an earlier time.

Habits and Habitat. This race, like *S. glaucus glaucus,* is commonly encountered about dwellings, and also on the trunks of trees where they hide under loose flakes of bark. They are seldom found on the ground or under ground litter, but on the other hand they do not appear to occur commonly above five or six feet. Except at dusk or night when prowling they appear to hide in cracks, crevices and other dark places. They are common enough in houses to have earned the Zapotec name of "gu-pay-yo" (house lizard).

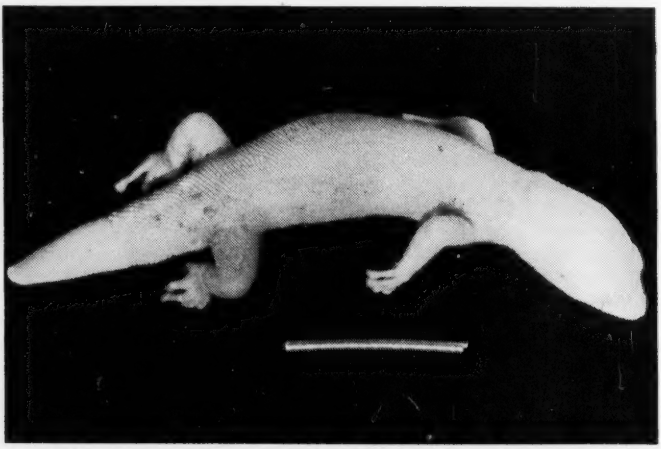
The adults have a tail gray in appearance which they wave slowly like a cat. Precisely the same nervous habit occurs in *S. g. glaucus.*

Comparisons. As stated previously, this race is distinguished from *S. glaucus* chiefly on the basis of differences in pattern. The elaborate pattern of the nominotypical subspecies, *S. g. glaucus,* has been well described previously (Taylor, 1947: 306-308; Smith, 1949: 34; Werler and Smith, 1952: 553). Additional specimens seen since the latter account was written bear out the indication that the typical pattern of *S. g. glaucus* is lacking in adults. Some very small specimens have small light flecks arranged in transverse series across the back; this is different from anything occurring in *S. g. glaucus* but matches the body pattern of most juvenile *S. torquatus.* The limbs of *S. g. inornatus* are but faintly barred, or not at all, in the young, whereas in *S. g. glaucus* they are prominently barred and spotted. Almost all *S. g. glaucus,* of all sizes, possess a dark, middorsal spot between the forelegs. This is lacking in all *S. g. inornatus.* Its presence or absence is the most conspicuous and useful distinction between the two forms. Some *S. g. inornatus* do have light lines on the side of the head (usually poorly defined), and light bars may persist dimly on the tail.

Status. Only one specimen has been taken in areas between the known range limits of *S. g. inornatus* and *S. g. glaucus,* where intergrades may be expected. This one, from Santo Domingo Petapa, Oaxaca (UIMNH No. 33685), we regard as an intergrade, although the status of any single specimen could not be positively stated. It does appear intermediate in pattern, having the light lines on head and light spots on limbs characteristic of *S. g. glaucus,* but also having a reduced nuchal dark spot. It resembles *S. g. glaucus* more closely than *S. g. inornatus,* and may actually represent a nearly typical population of the former race; only a larger series can verify the status of the populations of this intermediate area. Since the locality, although on Atlantic slopes of the Isthmus, possesses a marked edaphic similarity to Pacific areas, at least some tendency toward *S. g. inornatus* is to be expected in that population. In any case, we re-

gard subspecific status justified on the bases of extensive similarity of the two forms in appearance, habits, habitat, and of apparent continuity of range.

Nomenclature. The identity of Peters' *S. inornatus* is probably impossible to fix at the present time, except arbitrarily. An excellent photograph of one of the types, very kindly supplied by Dr. Eisentraut of the Berlin Museum (see Pl. 1) clearly reveals the smooth scales of this species (definitely eliminating Barbour's allocation of the name to the keeled *S. lineolatus*), but equally clearly reveals the bleached condition of the specimen. Differentiation of *S. g. glaucus* and the Tehuantepec race is, at the present time, impossible except in color characters. We allocate the name *inornatus* with the Tehuantepec race for three reasons: (1) much of Peters' material is known to have come from Pacific slopes; (2) the specimen does now fit in color, and was earlier described by Peters to be of the same color as, the Tehuantepec race; and (3) Smith and Taylor (1950: 53) have already restricted the type locality to Tehuantepec (City).



Pl. 1. A syntype of *Sphaeriodactylus* [sic] *inornatus* Peters, Berlin Mus. No. 4589. Photo courtesy Dr. Eisentraut.

Sphaerodactylus torquatus Strauch

Sphaerodactylus torquatus Strauch, Mem. Acad. Imp. St. Petersbourg, 1887, (7) 35 (2): 35-36; Taylor, Univ. Kans. Sci. Bull., 1947, 31: 302-305, fig. 1 (an excellent description, illustration).

Type. Petrograd Mus. No. 3268, 3 syntypes. H. Salmin, Coll., 1871.

Type Locality. "Mazatlan," here restricted to San Juan Mazatlán, Oaxaca (locally called Morro Mazatán [sic] or simply Morro, a town not to be confused with El Morro, a nearby coastal promontory without habitations).

Diagnosis. A smooth-scaled *Sphaerodactylus* differing as follows from *S. glaucus*: (1) a double black ring on neck; (2) in the young, a series of light crossbands or transverse rows of light spots on trunk; (3) adults

usually nearly unicolor except for collar and dark rings near tip of tail; (4) terrestrial (not arboreal except presumably when frightened); (5) tail pink below, the tip pinkish both above and below; and (6) tail tip not waved in life.

Range. The range at present appears to coincide with that of *S. g. inornatus,* except presumably in the center of the Isthmus where the two subspecies of *S. glaucus* intergrade. Neither species penetrates areas of high elevation, nor do they appear to occur in the low areas about the Lagunas or west of Mazatlán.

Locality Records. Actual localities from which the species is known are: San Juan Mazatlán (type locality), San Pablo (1) (near south end of C. Guiengola), Cajón de Piedra (Smith 1949), El Limón (Smith 1949), El Tanque (25), Río Hondo (1), Potrero Hierba Santa (2), Santa María (1), Guie-shaya (2000 ft.) on Cerro de Mixtequilla (1), and Ocotito at northwest end of Cerro Guiengola (1). Reliable sight records (MacDougall) are available for Zapote, La Mata, Río Costoche, San Bartolo Yautepec, Guigoguenda, Río Tequisistlán, Escurano, and San Antonio. We also have available 11 specimens from the "Tehuantepec" area.

Specimens Examined. Available at the present are 43 specimens. Twelve others have been critically examined at earlier times, but are not now available. Since this species does not occur commonly about human habitations it is seldom seen by most collectors. Except at a very few localities where specimens are abundant, most specimens found were saved.

Habits and Habitat. Although trees are available in areas inhabited by *S. torquatus,* the species occurs exclusively, so far as we are aware, on the ground. Specimens are found by turning stones and particularly fallen logs. This is in marked contrast to *S. glaucus* (both races) which is strongly scansorial. Further contrast is seen in the apparently complete absence of *S. torquatus* from domestic dwellings (except under aberrant conditions described hereinafter), whereas *S. glaucus* is common to them. In addition the nervous waving of the tail, characteristic of *S. glaucus,* is not seen in *S. torquatus,* in which the tail is pink instead of gray.

Comparisons. Invariably *S. torquatus* can be distinguished from either subspecies of *S. glaucus* by the presence of a black neck collar. In most specimens both bands are broad and continuous (see Taylor, 1947: fig. 1), but in rare specimens one band is scarcely visible, or both may be rather narrow. No specimens have been seen, however, that were not immediately recognizable by having a collar.

In addition, the young *S. torquatus* have transverse light bands, often broken into transverse series of light dots, on the back and tail. These disappear in adults, in which the ground color is more or less uniform gray, much as in adult *S. glaucus inornatus.*

Status. Taylor (1947: 302) was the first to revive this species in recent times. Smith (1949: 35) regarded it as a subspecies of *S. glaucus* on the basis of two specimens with a relatively poorly developed collar.

Despite the absence of known differences other than pattern between *S. glaucus* and *S. torquatus* extensive field work in the Tehuantepec area has revealed that the ranges of the two forms overlap over an extensive area, without observable blending. Furthermore, the two are definitely known to be sympatric at San Antonio, Guiengola, Ocotito, Cajón de

Santo Domingo
Petapa
Zapote
La Mata
Juchitán
Laguna Superior
Laguna Inferior
Mixtequilla
Tehuantepec
Santa María
Salina Cruz
between Morro and Guelaguichi
Nejapa
Guigoguendo
Jalapa
Guie-Shaya
Guiengola
San Pablo
Hierba Santa
El Tanque
San Bartolo Yautepec
Río Hondo
Río Costoche
Tequisistlán
Escurano
Río Tequisistlán
San Antonio
El Limón
Cajón de Piedra
Mazatlán

Piedra, Río Costoche, Escurano and Guie-shaya. Since there is rather sharp ecological segregation, a true sympatry actually may not exist, for although occurring at the same localities one is restricted to the ground away from human habitations, the other to situations above ground in or near human habitations. Nevertheless the contact of ecological range does occur unquestionably, and yet the forms maintain their separate identity throughout the area of contact. We accordingly believe the only reasonable conclusion is that these two forms behave like species.

Largely because of differences in habitat preference, each species exists in many areas completely to the exclusion of the other. At El Tanque, where many *S. torquatus* have been seen and taken, no *S. glaucus* have ever been discovered. And on the contrary, around Tehuantepec and Mixtequilla *S. glaucus* occurs almost or entirely to the exclusion of *S. torquatus*. The two species are thus sympatric in a broad, geographic sense (megasympatric), but are allopatric ecologically (microallopatric). In other terms, they are macrogeographically sympatric, microgeographically allopatric. This is precisely the expectation for closely related species. They appear to be reproductively isolated (save under disturbed conditions described later), but in lacking hybrid sterility they are ecospecies, not cenospecies.

Hybridization. As pointed out before (Smith, 1949) some specimens interpretable as intermediates between *S. torquatus* and *S. glaucus* have been taken. Two are recorded by Smith (1949: 34) from Cajón de Piedra: they are described as having "irregular, black, double collar." One from El Tanque (UIMNH 20601), one from Río Hondo (UIMNH 33178) and one from an unknown specific locality (UIMNH 19695 "Tehuantepec") have both collars narrow but clearly evident. One from San Pablo (UIMNH 20618) has the posterior collar virtually indistinguishable, although the front collar is of normal width; in this particular specimen the complex juvenile pattern of transverse crossbands is clearly evident, although the specimen is an adult (23 mm. snout to vent). All these are interpreted as falling within the extremes of the normal range of variation, and not as hybrids or intergrades. We are led to this conclusion by the fact that some of these extremes occur at places where no *S. glaucus* have ever been taken (*e.g.* El Tanque, San Pablo). The variants could still be taken as intergrades, except that the forms do occur together at some places, there maintaining separate identity at least for the most part. Clearly no free or even frequent interbreeding is indicated.

Yet that some interbreeding does occur in certain areas seems likely. One adult from San Antonio (UIMNH 33188) and one from Guie-shaya (UIMNH 33187), at both of which localities both forms occur, have a very faint double black collar, with a light crossband enclosed between the two darker bands. This pattern is scarcely evident to the naked eye,

Fig. 1. Distribution of *Sphaerodactylus glaucus inornatus* (circles) and *S. torquatus* (triangles). The solid circle indicates a hybrid between *S. g. glaucus* and *S. g. inornatus;* the solid triangles indicate hybrids between *S. g. inornatus* and *S. torquatus* as well as typical examples of both forms. The heavy line outlines the approximate range limits of both *S. torquatus* and *S. g. inornatus;* the vertical lines indicate part of the range of *S. g glaucus;* and the cross-hatched zone indicates the approximate presumed area of intergradation between *S. g. glaucus* and *S. g. inornatus.*

but is clearly visible under magnification. The body of each specimen is coarsely stippled as is common in either form. The conclusion that this pattern is a result of interbreeding seems inescapable. How frequently interbreeding occurs could perhaps be safely judged on the basis of large series, but these are lacking. The few other specimens available from each locality fall readily into the normal range of variation of one form or the other, both being represented at each place.

An extremely interesting situation exists at Santa María, a barrio of the town of Tehuantepec. Here, as elsewhere in towns, *S. glaucus inornatus* is common. We have 9 specimens representing that form from the house of one of the local collectors. This collector is occupied as a woodcutter, however, and he frequently unloads at home cut wood hauled in from areas where *S. torquatus* is the sole representative of the genus. Thus we have one typical *S. torquatus* from this same house. More important, 4 other individuals, also from the house (UIMNH 33681-4) are intermediate, and may with some reliability be regarded as hybrids. The four hybrids vary in size from small to large (15 to 27 mm. snout-vent), and have poorly defined collars also varying from bare perceptibility to distinct rudiments. In this case the presumed hybrids are almost certainly a product of an unnatural disturbance of populations; without artificial transportation of *S. torquatus* into a habitat it normally does not occupy no interbreeding probably would have occurred. That the supposed hybrids from Guie-shaya and San Antonio are of comparable origin seems a reasonable possibility, especially since they were caught by local collectors.

The Origin of S. g. inornatus. The status of *S. torquatus* is not the only problem involved in the present situation. The origin of *inornatus* is equally perplexing and considerably more devious. As suggested earlier (Smith, 1949: 34) the individuals here referred to this subspecies appear intermediate in some respects between *glaucus glaucus* and *torquatus,* indicating that they possibly constitute an intermediate, intergrade population resulting from the interbreeding of *torquatus* and *g. glaucus.* We do not believe this is actually the case, however. We believe it most likely that *inornatus* evolved as a product of hybridization of *torquatus* and *glaucus,* for it possesses no known unique characters but blends those of the other two forms. In some manner, however, these hybrids apparently became more or less consistent in appearance, eventually occupying a distinct range, maintaining their appearance throughout that range, and cohabiting that range with one of the parent forms.

The hybrid origin of *inornatus* could have come about in any one of three different ways. For one, the formerly isolated *glaucus* and *torquatus* could, when their ranges came into contact (as for example at the closure of the Tehuantepec portal in Pliocene times) have interbred freely, developing an intergrading population in an intermediate zone. Subsequently the conditions would necessarily have ceased to permit interbreeding between *torquatus* and the intergrades, the latter of which however would have maintained their intermediate character and become recognizable as a separate subspecies *(S. g. inornatus).* This would be origin by *secondary intergradation,* as commonly defined *(e.g.* Blair, 1951: 22). This method seems unlikely because of the relatively uniform character of the differentiated population *(inornatus).* Secondary intergrades as a rule at least at early stages have a wide range of variation equalling or exceeding that of both parent populations.

A second method may have occurred under conditions of *primary intergradation,* whereby *g. glaucus* and *torquatus* may be conceived as occupying their present ranges, approximately, with a zone of intergrade populations lying between. Subsequently *torquatus* would presumably have developed some feature (as for example a different habitat preference or different habits), linked with the pattern character, that ultimately prevented interbreeding with the non-collar-bearing populations. The intergrade population would then have possessed approximately the relationship, between *g. glaucus* and *torquatus,* that *inornatus* is now known to possess. This method of origin remains a distinct possibility.

A final method of origin may have been by interspecific *introgression* (like Blair, *op. cit.,* we prefer to restrict application of this term to interspecific, not intraspecific, hybridization). This presupposes the former existence of two species, *glaucus* and *torquatus,* with approximately the same ranges as at the present time. Occasional interbreeding, even as now is known to occur, could eventually introduce certain characters of one genome into the other. The new combination would be expected, if of adaptable value, to spread throughout the natural area in which it conferred superiority. It may be presumed that this combination, as expressed in *inornatus,* has reached a stability in the obviously natural area it now occupies. This method, because of its simplicity and support in terms of facts observable at the present time, appears to us as the more plausible of the three.

As a secondary point, it seems worthwhile to maintain introgression and secondary intergradation as distinct concepts, solely upon the basis of the degree to which the genome of either species is altered by the other. In secondary intergradation the two forms maintain their *original* identity despite the occurrence of interbreeding in an intermediate zone; selection, among other factors, might work to maintain the original identities. In introgression certain characteristics of one form successfully spread in the other resulting in formation of a recognizably different genome.

SUMMARY

Three distinct forms of *Sphaerodactylus* are reliably known to occur in Mexico: *S. g. glaucus,* on Atlantic slopes below about 800 feet elevation from central Veracruz to Petén and British Honduras, including the Yucatán Peninsula; *S. g. inornatus,* on Pacific slopes west of the center of the Isthmus of Tehuantepec, up the valleys of the Tehuantepec and Tequesistlán rivers; and *S. torquatus,* with approximately the same range as the latter.

The three forms may be distinguished by the following key:

1. A distinct, usually double, black collar across back and sides of neck ..... *S. torquatus*

   No complete collar 2

2. A black dot in middle of nape of neck, and one on either side of rump; a light spot on each knee, often on each elbow; a distinct light band across distal portion of thighs and lower foreleg; a distinct light line on posterior surface of thigh, extending onto base of tail; pattern described especially well defined in juveniles ..... *S. g. glaucus*

More or less unicolor above, even in juveniles; pattern if present not as described ..... *S. g. inornatus*

The form *inornatus* is thought to have evolved by hybridization. This hybridization was probably not of secondary intergradation, but was possibly primary intergradation, or, more likely, introgression. The conditions now existing do not permit more than rare interbreeding between the hybrid product *(inornatus)* and one parent *(torquatus)*, but may do so with the other parent (*glaucus*).

S. g inornatus has, in post-hybridizing periods, developed a range, character and constancy that merits its recognition as a subspecies.

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AND 4000 BOSTON ROAD, NEW YORK CITY, N. Y.

A Preliminary Report on the Subspecies of the Western Fence Lizard, *Sceloporus occidentalis*, and its Relationships to the Eastern Fence Lizard, *Sceloporus undulatus*

By EDWIN L. BELL

The relationships between the eastern fence lizard, *Sceloporus undulatus*, and the western fence lizard, *Sceloporus occidentalis*, have remained in doubt for years. Burt (1933) considered them as one species with a transcontinental distribution. Smith (1938) claimed that the two were separate, and should not be united. Other authors have followed various taxonomic schemes in dealing with one or more races of these two similar species.

A systematic study of the subspecies of *S. occidentalis* and their relationships to *S. undulatus* has been in progress several years. Since important taxonomic changes are warranted, and since the detailed account may be delayed in publication, a preliminary account is presented. Use of the key to the subspecies of *S. occidentalis* must of necessity be circumspect, for difficulties may be anticipated due to (1) insufficient number of mature specimens, (2) improperly preserved specimens, or (3) insufficient number of specimens of a particular sex.

The shape and coloration of the blue gular and belly patches in mature specimens is one of the most important diagnostic characters in this species. In preservation every effort should be made to prevent the blue from fading. Preservation should be attempted immediately after killing the specimens. Very little or no fading will result if specimens are fixed and preserved in alcohol, either ethyl or isopropyl. If formalin must be used, the body cavity should be injected by syringe with formalin no stronger than one part of full strength formalin to nine of water. The specimen should then be placed in 70% alcohol. This fixes the specimen quickly, and fading is held to a minimum. Immersion in formalin should be avoided. If immersion in formalin is the only means of preservation available, then the body wall should be slit, and the specimens removed from the formalin if possible within the hour, washed, and transferred to alcohol. Prolonged immersion in formalin will probably render specimens useless for study of color characters.

The ranges of *S. o. longipes* (inhabiting the Great Basin) and *S. u. elongatus* overlap in southwestern Utah. *S. u. elongatus*, invading from the east, occurs west to Beaver Canyon, Beaver Co.; Paragonah, Iron Co.; Bellevue, Ash Creek, and Springdale, Washington Co., Utah. Populations probably exist farther westward in the Virgin River Valley, since this race has also been taken at Lake Meade in Nevada. *S. o. longipes*, invading southwestern Utah from the west, extends eastward to Beaver, Beaver Co.; Panguitch, Garfield Co.; 8 miles west of Cedar City, Iron Co.; Grapevine Spring, south Ash Creek, and 10 miles west of St. George, Washington Co., Utah. No evidence of intergradation in two key characters, (1) shape of blue gular patches and (2) arrangement of scales on posterior surface of thigh, has been apparent in specimens within the area of overlap, which is approximately twenty miles wide. The only actual count that may be used with any reliability to separate these two races is the number of scales between the medial ends of the right and left femoral pore series.

Other scale counts do not differ, but the similarity is not thought to be due to intergradation, but to convergence.

Reviewing these interspecific differences, mature male *S. o. longipes* have a single medial blue gular patch; occasionally the entire area from the throat to the edge of the chin is blue. Males and females of *S. u. elongatus* have two small lateral blue gular patches tipped with black anteriorly. Female *S. o. longipes* do not exhibit as bright or as distinct blue gular patches as the males do. Females of *longipes* may have two distinct gular spots. The position of the spots, however, is not the same as in *S. u. elongatus*. In *S. o. longipes* the spots are, when paired, more medial in position than in *S. u. elongatus*. Although the divided gular spots of immature *S. o. longipes* may occasionally resemble those of *S. u. elongatus*, it is not thought that this is due to genetic influence of *S. undulatus*. Adult males of these two races are always easily separated by the shape of the gular patches. Also, immature female *S. o. longipes* with divided gular patches occur throughout the range of this race: whereas, if it were due to current exchange with *S. undulatus*, one would expect this resemblance to be limited to, or more prominent in, that part of the range closest to the range of *S. undulatus*.

The arrangement of the scales on the posterior surface of the thigh differs not only in the overlapping races, but between all races of *S. occidentalis* and all races of *S. undulatus* as well. In *S. occidentalis* there is a sharp line of demarcation between the smaller scales on the posterior surface and the larger scales toward the dorsal surface of the thigh. Using single specimens, however, this diagnostic character is difficult to evaluate, especially if one is not familiar with it; if possible, comparisons should be made with several specimens. The line of demarcation may be less distinct in some specimens of *S. occidentalis*, but it is totally lacking in *S. undulatus*.

The number of scales between the femoral pore series is the best objective distinction between the two species in the region of overlap, but unfortunately some overlap in range of variation exists. This count has a range of 5-9, with a mean of 7.72 in 65 *S. u. elongatus* from Washington Iron, and Beaver cos., Utah. It has a range of 6-16, with a mean of 9.87 in 517 *S. o. longipes* from the Great Basin. The distribution of these counts is such that if the specimens were lumped and all specimens with scale counts 9 or higher were considered as *S. o. longipes*, and those with counts 8 or less were considered as *S. u. elongatus*, 81% and 93% of the specimens, respectively, would be correctly identified. This is the best scale count to use in distinguishing these two races. It may be added that *S. o. longipes* is also slightly larger than *S. u. elongatus*.

The races of *S. occidentalis*, where there is no physiographic barrier, typically show a broad band of intergradation at least 10 miles wide between adjacent subspecies. Intergradation zones are narrower but still present where physiographic barriers exist. A totally different phenomenon occurs between *S. o. longipes* and *S. u. elongatus*, where an overlap approximately 20 miles wide exists. The morphological gap and geographical approximation between these two forms is accordingly greater than that between any of the races of *S. occidentalis*, and presumably between any of the races of *S. undulatus*. This divergence is taken to be indicative of specific rank.

Accounts of the subspecies of *S. occidentalis* follow.

Sceloporus occidentalis longipes Baird

Type Description. Baird, 1858, p. 254.

Type Locality. Fort Tejon, Kern Co., California.

Type Specimen. A lectoholotype is here designated as USNM 4358A.

Diagnosis. Mature males almost always with a single large blue gular patch of uniform intensity throughout; chest, thighs, and area between belly patches ranging from light gray to black, almost always darker than *S. o. occidentalis.* Size large, attaining a body length of 97 mm. Distinguished from *S. o. biseriatus* by having dorsal count (number of scales along mid-dorsum between interparietal scale and an imaginary line across base of tail connecting posterior surfaces of thighs) 45 or less, and having ventral scale count (number of scales just to one side of mid-venter between postmental scale and edge of vent) 85 or less.

Range. This race has a split range. The larger area is in the Great Basin, including Inyo, Mono, and northern San Bernardino cos., Cal., all of Nevada except the extreme southern part, Utah west of the Wasatch Mts., and also in western Garfield Co., Utah. It ranges northward into southwestern Idaho, eastern Oregon, including the Blue Mts. area, north in eastern Washington to the vicinity of Spokane. The smaller area is in southern coastal California from central Los Angeles Co. southward, between the desert and the Pacific Ocean, to the Sierra San Pedro Martir range in northwestern Baja California, Mexico.

Sceloporus occidentalis biseriatus Hallowell

Type Description. Hallowell, 1854, p. 93.

Type Locality. This race was described by Hallowell from "the borders of El Paso Creek and in Tejon Valley." It was restricted by Smith and Taylor (1950) to El Paso Creek. Their restriction is followed here. Hallowell (1854) also described two varieties of *biseriatus, azureus* and *variegatus,* from the same type localities cited above. The type localities of *azureus* and *variegatus* are here restricted to El Paso Creek, placing them in the synonymy of *S. o. biseriatus.* El Paso Creek and Tejon Valley are close together in the Tehachapi Mts., Kern Co., Cal., and are in the same intergrade area (*S. o. longipes* X *biseriatus*). This makes Baird's *S. longipes,* with type locality at Ft. Tejon in a different intergrade area (*S. o. longipes* X *bocourti*), available for the populations in the Great Basin and southern coastal California.

Type Specimen. A lectoholotype is here designated as Acad. Nat. Sci. Phila. 8476.

Diagnosis. Mature males generally with large single gular patch, occasionally two lateral patches; usually smaller pin-point light flecks within blue gular area. Dorsal count 46 or higher, ventral count 86 or higher. Blue belly patches generally black-bordered in males, and generally separated medially by a lighter area.

Range. This race inhabits the lower San Joaquin Valley from Fresno and Yosemite National Park south to the Tehachapi Mts. It intergrades with *S. o. occidentalis* on the north above Fresno, with *S. o. longipes* in the Tehachapi Mts., and with *S. o. bocourti* on the western edge of the San Joaquin Valley and inner Coast Range south of Pachèco Pass to Fort Tejon.

Sceloporus occidentalis taylori Camp

Type Description. Camp, 1916, p. 65-67.

Type Locality. Halfway between Merced Lake and Sunrise Trail (Echo Creek Basin), altitude 7500 ft., Yosemite National Park.

Type Specimen. Holotype Mus. Vert. Zool. 5947, a male 84 mm. in body length with excellent color preservation.

Diagnosis. Ventral scale count 86 or higher. In males having body length 80 mm. or more, venter blue throughout, belly patches not separated by a lighter area. Chest generally a lighter shade of blue than gular or belly patches. Smaller males generally not distinguishable from *S. o. biseriatus.*

Range. The higher Sierra Nevada Mts., above approximately 7000 ft., from Yosemite National Park south into Tulare Co.

Sceloporus occidentalis becki Van Denburgh

Type Description. Van Denburgh, 1905, p. 2-4, 9-10.

Type Locality. San Miguel Island, Santa Barbara Co., Cal.

Type Specimen. Cal. Acad. Sci. 4357, collected by R. H. Beck.

Diagnosis. Gular patch black, extending across gular area from shoulder to shoulder; area on chin and throat anterior to black patch light blue, crossed by lines of blue-black radiating forward from the black patch.

Range. An insular race, inhabiting the Channel Islands, including Santa Cruz, Santa Rosa, and San Miguel Island off the coast of southern California.

Sceloporus occidentalis occidentalis Baird and Girard

Type Description. Baird and Girard, 1852, p. 175.

Type Locality. No type locality, other than "California," was designated in the type description. Grinnell and Camp (1917) restricted the type locality to Benicia, Solano Co., Cal., by inference from Baird's next published record of this form (Baird, 1859).

Type Specimen. A neotype, collected by R. C. Stebbins at Benicia, Mus. Vert. Zool. No. 59874.

Diagnosis. Adult females with 5 or more gular scales that are 50% or more blue; females almost always with two blue gular spots. Males with 20 or more gular scales that are at least 50% blue; males generally with two intensely blue lateral gular spots, connected medially by a narrower, lighter blue band, or with two separate lateral blue gular spots, rarely with a single entire blue gular patch. A slightly higher percentage of separation from *S. o. bocourti* is attained when females alone are used for diagnosis. Chest, thighs, and area between belly patches cream, white, or gray, generally lighter than in *S. o. longipes.* Body size smaller than *S. o. longipes.*

Range. In Washington and Oregon it occurs in the less humid portions of the coast forest. In Washington it occurs in the Puget Sound region, and the Columbia River valley in Skamania and Klickitat cos., north on the east slopes of the Cascades nearly into Canada. In Oregon it occurs in the Columbia River Valley from the Deschutes River Valley to the Portland area, the Williamette Valley, the Coast Range south of Marshfield, and the southern Cascades below Crater Lake. It does not occur in the humid Coast Range north of Marshfield, or in the Cascades above the Transition life zone. It intergrades with *S. o. longipes* in north-

eastern California and south-central Oregon. In California it occupies the Coast Range from Oregon south to San Francisco Bay, the Sacramento Valley, south into the upper San Joaquin Valley in Merced Co., and in the Sierra Nevada Mts. from Oregon south to Yosemite National Park. It intergrades with *S. o. biseriatus* in the San Joaquin Valley, and with *S. o. bocourti* in the inner Coast Range from Alameda Co. south into San Benito Co., Cal.

Sceloporus occidentalis bocourti Boulenger

Type Description. Boulenger, 1885, p. 229.

Type Locality. Boulenger cited Santa Cruz, Monterey, and Mt. Whitney as type localities. The type locality is here restricted to Santa Cruz, Santa Cruz Co., California.

Type Specimen. British Museum (Natural History) no. 1946-9-6, 98.

Diagnosis. Adult females with 4 or fewer gular scales that are more than 50% blue. Most of the adult females examined have no blue gular patches. Males with small gular patches, the number of gular scales 50% blue or more generally 20 or less. A slightly higher percentage of separation from *S. o. occidentalis* is attained if diagnosis is based solely on females. Body of the same general proportions and size as *S. o. occidentalis.*

Range. The Coast Range from San Francisco Bay south to Santa Barbara Co. The inner Coast Range north of Pacheco Pass is inhabited by pure *bocourti* with a narrow intergrade zone with *occidentalis* along the eastern foothills. South of Pacheco Pass the inner Coast Range is inhabited by intergrades. The intergrades of *bocourti* X *occidentalis* extend south to the Coalinga area, and *bocourti* X *biseriatus* from the Coalinga area south to Fort Tejon. The Coast Range from Santa Barbara Co. south through all of Ventura Co. to northwestern Los Angeles Co. is inhabited by intergrades (*S. o. bocourti* X *longipes*). There is a gradual transition from the characters of one to the other race in the latter area, but some populations show chaotic variation, particularly in Ventura Co.

Key to Subspecies of *S. occidentalis*

1a. Gular patch black; chin crossed by blue-black lines radiating forward from gular patch ..... *becki*
1b. Gular patch, or patches, blue, or absent; chin not crossed by conspicuous lines 2
2a. Ventral scale count of population 86 or more 3
2b. Ventral scale count of population 85 or less 4
3a. Adults of body length 80 mm. or more with blue belly patches united, light blue on chest uniting blue of gular with blue of belly patches; no black borders on belly patches of fully adult males ..... *taylori*
3b. Adult males never with blue of belly patches united; no blue on chest; belly patches generally with black medial borders in adult males ..... *biseriatus*
4a. Adult males generally with single blue gular patch of uniform intensity throughout; chest, area between belly patches, and thighs generally dark colored; attaining a body length of 97 mm. ..... *longipes*
4b. Adult males generally with two intense blue gular spots laterally, and lighter blue between the spots, or with two separate gular spots, or

with gular spots absent; thighs generally lighter; body length 75 mm. or less 5

5a. Adult females generally with two blue lateral gular spots, with lighter blue between the spots medially, or with two separate gular spots; total number of gular scales which are at least 50% blue 5 or more in females..... *occidentalis*

5b. Adult females either with no blue gular patches, or with the total number of gular scales that are at least 50% blue 4 or less.... *bocourti*

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DEPT. ZOOLOGY, UNIV. OF ILLINOIS, URBANA, ILL., AND
DEPT. BIOLOGY, MORAVIAN COLLEGE, BETHLEHEM, PA.

The Economic Status of the Toad

By W. J. HAMILTON, JR.

As a predator of injurious insects, the toad has been credited with considerable economic importance as a biological control agent. The genus *Bufo* is cosmopolitan; it occurs in one form or another over much of North America, occupying variable ecological niches. Toad dietary consists primarily of ground-inhabiting invertebrates. Many small creatures that move within range of the agile tongue are swept into the mouth. For years, this amphibian has been credited with a value to the agriculturist quite out of keeping with the known facts.

To place a specific monetary value on any animal which may aid man in the control of insect pests is ridiculous. Unfortunately, such an attempt has been made repeatedly. Kirkland (1897, 1904) made the statement, oft repeated, that the annual value of an individual toad (*Bufo terrestris americanus*) to man was $20. Garman (1901) summarized the stomach contents of twenty Kentucky toads and implied an economic value of some importance. Bragg (1943) has accepted Kirkland's estimate of toad worth to man, and accordingly places the annual value of an Oklahoma toad (dependent upon the species, size and abundance) at from $15 to $25. Teale (1948) implies that the value of the toad has soared with the value of the crops it reputedly saves, and now labels *Bufo* as a hundred dollar asset.

Undoubtedly the toad, as with other predators, has a certain value in minimizing the frequent disastrous outbreaks of insect pests. Occasionally it may prove to be one of the more important natural agents in the biological control of terrestrial arthropods. We must remember that the toad feeds on almost any invertebrate that is small enough to be captured. Snails, slugs, millipedes, spiders, phalangids, insects and a host of other small fry serve its needs.

Specific examples of the toad's value to man are not wanting. Introduced into Puerto Rico in 1920, the Marine Toad, *Bufo marinus,* changed the status of the white grub (*Phyllophaga*) to the sugar industry from a major problem to one of minor consequence (Van Volkenberg, 1935). There are numerous records of the beneficent introduction of this large bufonid into several of the West Indian Islands, Hawaii, the Philippines and Australia. Toads may exhibit the same adaptability in feeding habits in the presence of an insect outbreak as do many birds and mammals. In 1921, the sugar-beet webworm invaded the beet fields of Cache County, Utah, in such numbers that many fields of beets were partly or wholly destroyed. Great numbers of toads, *Bufo woodhousii,* either attracted to the fields or already present, were found to be feeding almost exclusively upon the webworms (Pack, 1922). Studies on the feeding habits of the Great Plains toad, *Bufo cognatus,* in North Dakota during the summer of 1943 indicated that the chief food of this anuran consisted of the sweet clover weevil, *Sitona cylindricollis.* This serious pest of clover occurred in 73% of the stomachs examined and occupied a third of

the total volume of all food eaten by the toads (Telford and Munro, 1944). Commending the South African *Bufo regularis* as an important controller of the beetle *Schizonycha*, Power (1931) records the leveling effect of this predator in reducing insects of economic significance. His examination of 30 specimens again suggests availability determines the dietary of a species.

In his volume on the biological control of insects, Sweetman (1936) asserts that garden pests can be effectually controlled on low growing plants by including toads to forage among them. He further states that a number of greenhouse pests that are difficult to control with insecticides, can be effectively controlled by placing a few toads on and under the benches. A toad or two liberated in the kitchen at night will reduce or eradicate cockroaches, according to this author.

In June, 1932, I introduced a dozen adult toads into a garden plot in which various annuals, principally asters, had been set out. These animals were marked, for growth studies were anticipated. The toads remained in the area, or close to the garden. The serious ravages of cutworms were no less evident than in the previous year, at which time two large toads were resident in the same garden. Attempting to control cutworm damage in two shallow 6′ x 6′ frames in which asters and other annuals had been transplanted, I introduced three toads into each frame. These were not fully adult, having a length of 32-40 mm. Cutworm damage continued severe, as it had been in previous years. Such damage might easily have been reduced by hand picking or poisoned baits, but it was my wish to determine the desirability of introducing toads into garden plots and frames as a control agent against the ravages of insects. A few greenhouse owners of my acquaintance have placed toads beneath the plant benches to control slugs. Plants had been set in the darkened areas below the benches, on the floor of the greenhouse. Slugs continued to be a nuisance after the introduction of the toads.

Toads may occasionally become a local pest. These animals certainly have no place in the apiary. They are frequently attracted to the hives, and may take an appreciable toll of bees just after sundown when the insects are clustered at the hive entrances. Examination of the stomachs and droppings of toads at the queen rearing yard of the University of California, at Davis, indicated the toad a serious predator of the bees (Eckert, 1934).

The food of the toad is largely determined by availability. If several hundred small toads are taken from the shelter of a manure pile, one will usually find 90% or more of the food consisting of a single item, *i.e.*, manure fly larvae, *Ceratopogon* (Hamilton, 1930). The writer has recently completed stomach analyses of 500 toads of several species (*Bufo t. terrestris, B. terrestris americanus, B. woodhousi fowleri,* and *B. quercicus*). The majority of those examined were taken in home gardens and small truck garden plots, at a time when the plants were small and most susceptible to cutworm damage. The results from one area, as indicated below, do not bear out the reputed value of the toad as an effective control agent of injurious insects.

TABLE I

Stomach contents of 40 adult toads *(Bufo terrestris americanus)* from garden plots of central New York. June 12-July 15, 1932-1948.

Food	Frequency of Occurrence	Per Cent by Bulk
Beetles	90.0	34.7
Ants	77.5	18.5
Centipedes	25.0	7.5
Spiders and Phalangids	52.5	4.0
Lepidopterous larvae	55.0	15.1
Millipedes	47.5	4.0
Sowbugs	30.0	6.4
Diptera	12.5	2.7
Molluscs	27.5	3.8
Hymenoptera	1.5	.7
Miscellaneous Arthropods (fragments)	22.5	2.6
		100.0

It is apparent that beetles and ants comprise the principal food in this analysis, occurring more frequently than other items and constituting more than half of the bulk. Most of the beetles were carabids, the dominant genera being *Anadaptus, Clivinia* and *Omaseus.* Staphylinids, coccinellids and a few scarabids (principally dung beetles) were recovered from the stomachs. Ants were taken in large numbers, the species most frequently eaten including several species of *Lasius, Formica* and an occasional *Camponotus.*

The diminutive oak toad, *Bufo quercicus,* of the southeastern states seldom exceeds an inch in length. The incredible numbers of this species more than atone for the small size. I have counted more than sixty in a two acre truck garden. Moreover, it is largely diurnal, foraging while other bufonids are inactive. Analyses of the stomach contents of 86 specimens from truck garden plots in central (Orlando) and southern (Tampa and Fort Myers) Florida during April and May reveals that 93% of the food by bulk constitutes ants and beetles. Ants occurred in more than 95% of the specimens. The more prominent species, both in frequency of occurrence and numbers eaten, include *Brachymyrmex debilis, Odontomachus haematoda, Solenopsis globularia* and *Dorymyrmex pyramicus.* Beetles which were eaten most frequently include *Eulimnichus ater, Ataenius gracilis, Hister americanus* and *Euphorticus pubescens.* A few small staphylinids, pselaphids and undetermined Coleoptera comprise the lot. The list of beetles does not indicate any pest; on the contrary those which are listed are neutral or possibly beneficial.

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An analysis of food items selected by toads in New York garden plots and from Florida fails to substantiate the claim that toads are a marked asset to man. By their destruction of useful carabids, coccinelids, staphylinids, spiders, phalangids and other beneficial arthropods, they may well offset any reputed value which might accrue through eating insect pests. The toad, like birds, insectivorous mammals and other vertebrates

which destroy insects, provides a minor regulating influence on the total number of insects. Toads fill an ecological niche, perhaps limiting in small measure the nocturnal ground dwelling invertebrates. One should recognize that biological control, insofar as the toad is concerned, is of relatively minor significance in regulating the undue increase of insect pests. Presently the toad plays an even lesser role with the advent of many new insecticides.

Thanks are due my colleague, Professor Henry Dietrich, for determination of beetles.

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DEPARTMENT OF CONSERVATION, CORNELL UNIVERSITY, ITHACA, NEW YORK

Desmognathus perlapsus Neill in North Carolina

By THEODORE H. EATON, JR.

On August 4, 1953, the writer visited the type locality of *Desmognathus perlapsus* Neill, on the west wall of Tallulah Gorge, in Rabun County, Georgia. Twenty-eight specimens were collected in the spot described by Neill (1950). As he indicated, the salamanders were crawling on wet rock surfaces where liverworts and clumps of moss grew, and took refuge also under leaf-trash and wet stones. The site is steep, with an average slope of at least 50°, and is at the upper edge of a mixed forest, above which a railroad and power line clearing traverses the hillside just below the rim. It is about 250 feet from the rim down across the tracks and precipitous incline to the point where the salamanders occur, but Neill's description made the place easy to find.

Study of this series is summarized below, but my main purpose here is to report discovery of the same species a few days later, August 13, in North Carolina. With the help of my wife, Grace J. Eaton, and children who found the first specimens, I collected a series of 41 on the southwest face of Cold Mountain, about 5 miles west of the village of Lake Toxaway, in Transylvania County but within a few hundred feet of the Jackson County line. The elevation here is approximately 4400 feet, and the site is a bare cliff of gray gneiss up to 100 feet high, down which water drips in a few wet strips. The entire cliff is about a quarter of a mile long; in two places there are deep recesses beneath. (This Cold Mountain is not to be confused with the higher one of the same name a few miles farther north, towards Waynesville.)

On wet boulders at the bottom of the cliff and in alga-grown wet spots on the cliff itself, *perlapsus* was abundant, crawling in the film of water just as at Tallulah Gorge, and showing the same characteristic color and pattern. Also found at the same site were three or four immature *Desmognathus ochrophaeus carolinensis*, and in pools close by were a few larvae of *D. monticola*. The range of variation in both the Georgia and the North Carolina series of *perlapsus* was greater than I had expected from Neill's paper, which, however, was based on a smaller number of specimens.

Eggs and Embryos. Under a clump of mixed sphagnum and grass, growing against the wet slope of a ledge, I found a cluster of seven eggs attended by a small female of *perlapsus* (snout-vent length 23 mm., total 48 mm.). Unlike the three complements reported by Neill, this contained only two eggs which were attached separately, the other five being united by short extensions of the thin, clear envelopes, and fastened at one point to roots. Fortunately it was possible to study these eggs, while still living, with a dissecting microscope (Fig. 1B).

Each capsule was oval, averaging 3.6 x 4.5 mm. The embryos, 11 mm. long, were within a day or two of hatching, and had small, creamy yellow yolks still showing on the abdomens. The dorsal pattern was already well developed (Fig. 1A), and they wriggled actively inside the thin capsules. The gills were present as slender filaments about equal in length to the fore legs; the first pair were bifurcate, the second and third trifurcate. The tail bore a slight keel on the distal half. The dorsal pattern, as shown by the figure, consisted of opposite or nearly opposite

light buff spots outlined in dark brown, and a median light streak. Heart, liver, gall bladder (dark green), and stomach were visible through the thin ventral skin just anterior to the yolk.

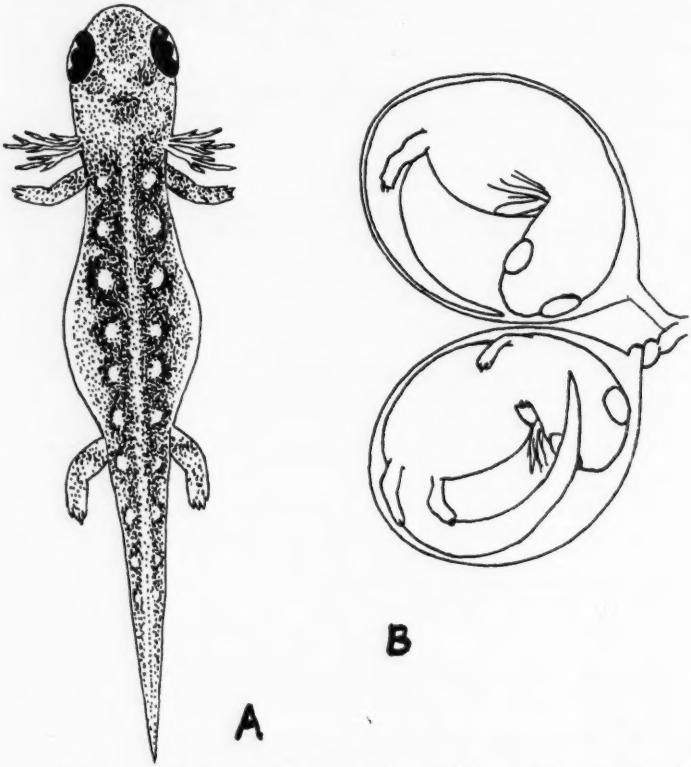

FIG. 1. A. Embryo of *Desmognathus perlapsus*, 11 mm., removed from egg capsule. B. Outline sketch of two embryos in capsules.

Variation. Tabulation of snout-vent lengths shows, in the Georgia series, three apparent size-groups: (1) 8 juveniles, probably of this season, ranging from 11 to 21 mm.; (2) 11, probably of the previous year, ranging from 24 to 29 mm.; and (3) 9, presumably two years old, ranging from 33 to 38 mm. In the Cold Mountain series there are 29 apparent juveniles, 12-21 mm., and 12 which seem to belong in the second group, 23-31 mm. Absence of the third group may be due to chance in collecting ("the biggest got away"). Probably two or three larger dark salamanders seen were *perlapsus*, but it may well be that the third group actually occurs in smaller proportion at Cold Mountain. It is worth noting that none in either series were as large as Neill's type specimen, and that he gave the average snout-vent length of adults as 38 mm.

The costal groove count in my material varies from 12 to 14, with a greater frequency of 12 in the smaller specimens, the larger ones showing 13 and 14 about equally, but rarely 12. The tail is keeled distinctly in 4 individuals, but normally is slender, round, and tapers to a fine point. Its length usually, but not always, becomes greater than snout-vent length in adults, but is equal or less in small ones.

The pattern and color are highly variable, as is the case with *D. ochrophaeus carolinensis*, yet it is possible to distinguish the two with little difficulty; *perlapsus* frequently (but by no means always shows 4 pairs of spots on the back between fore and hind limbs, and the silvery dotting and white-mottled sides are usually easy to recognize. The dorsal spots are brightest and most conspicuous in the young ones, being pale straw yellow, light buff, gray-brown, silvery reddish, chocolate, or even orange, outlined partly or completely in black or dark brown, or set in a ground-color of brown to mahogany. The darker ground-color and less distinct pattern characterizes larger specimens. Spots often run together across the middle line, either in the whole dorsal pattern or in part of it, and they alternate as frequently as they are opposite, often both in the same specimen. A zigzag pattern occurs in several.

Relationships. I am inclined to regard *perlapsus* as most closely related to *D. o. carolinensis*, of which I have a large number from the Cold Mountain area, for the following reasons:

1. Pattern and color variation are of essentially the same extent and character in both, and are greater than in any other Plethodontids of my acquaintance.

2. The habitat is roughly the same for both, in spite of the distinction suggested by the expression "cliff-dweller" applied to *perlapsus*. No other *Desmognathus* in the region occurs regularly in wet, rocky places, near but not in streams.

3. Absence of an aquatic larval stage in both distinguishes them from *D. fuscus, quadramaculatus*, and *monticola* (*phoca*), the other widespread southern Appalachian species. Neill noted the separate attachment of eggs in the three complements he found, while in mine only a part were separate the others together, and their situation was much like that used by *carolinensis*.

4. In examining these two series of *perlapsus* I have sensed no close resemblance to *fuscus* or *quadramaculatus*, although there is an occasional pattern somewhat suggestive of *monticola*. This, of course, is a negative and highly subjective comment, and is included only to emphasize the equally subjective opinion that *perlapsus* is derived from the wide-ranging and variable *D. o. carolinensis*.

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EAST CAROLINA COLLEGE, GREENVILLE, N. C.

GYRINOPHILUS PORPHYRITICUS DURYI (WELLER) IN VIRGINIA.—In November, 1950, I accompanied members of the Cave Club from Virginia Polytechnic Institute on a weekend trip to visit certain caves in Tazewell County, Virginia. After a nocturnal visit to Cauliflower Cave near North Tazewell, I had the opportunity to investigate a hillside above the cave and was fortunate to find a *Gyrinophilus p. duryi* perched upon a rock situated in the midst of a large springy area. This salamander was compared with material in the United States National Museum and also with published descriptions and there seems to be little doubt as to its taxonomical status. Measurements and counts on this specimen are as follows: total length, 128 mm.; snout to anterior angle of vent, 75 mm.; costal grooves, 17, or 18 when an indistinct branch is counted in the groin; intercostal grooves, left side, 7, right side 6; vomerine teeth, left series to curve, 9 (total 18), right series to curve, 8 (total 17).

To the best of my knowledge this is the first published record for *duryi* in Virginia, although Barbour (1953, Copeia (2): 86) reports this salamander from nearby Black Mountain in Kentucky. In contrast to these two records, Mittleman (1942, Proc. N. Eng. Zool. Club, 20: 28) states that this subspecies is ". . . well restricted to the southern tier of counties bordering the Ohio River. . . . " Bishop (1943, Handbook of Salamanders: 362) generally supports this view with his map defining the ranges of the various races of *Gyrinophilus*. A close examination of this map reveals a hiatus between typical *porphyriticus* from the western portion of Virginia roughly north of the James River drainage and *danielsi* along the southwestern Virginia border to the south. The Black Mountain region appears also to be included in this area to the west. The two records for *duryi* from Tazewell County, Virginia, and Black Mountain, Kentucky, plus other specimens of *Gyrinophilus* I have collected from Rockbridge, Giles, Montgomery, and Tazewell Counties in Virginia, make it fairly evident that this situation is due largely to a lack of collecting in critical areas. These additional Gyrinophilids from Virginia are being studied at the present time.—Walter B. Newman, Hyattsville, Maryland.

Miscellaneous Observations on Captive Testudininae

By Ronald E. Beltz

The tortoises herein described have been kept together in the same enclosure for a period beginning in May, 1952, and extending through October 20, 1953.

Testudo elegans Schoepff

The sole representative of this species, the beautiful Indian Star Tortoise, was a small adult female purchased from a dealer in Calcutta, India. This tortoise arrived in Los Angeles in early May, 1952. No collection data were available.

At first the tortoise was quite active in her efforts to escape from the enclosure, but after becoming accustomed to the new surroundings, she proved to be the most phlegmatic of all the turtles. No tortoise is more adept at self concealment than this creature. Even in full view and bright sunlight, the *elegans* always is the last chelonian to be located. Generally she will settle in a tall tuft of grass, invariably in the shade, and remain there motionless for the greater part of the day. Should she be under the small *Pittosporum tobira* in the rear of the enclosure, the sunlight filtering through the leaves renders her invisible.

This *elegans* will eat ground meat readily. Upon the suggestion of Nichols (1953), I placed a few halves of egg shell in the enclosure and was amazed to see the *elegans* devour a whole half. Whenever the Star Tortoise happens to be tipped over, for one reason or another, the highly convex carapace seems to facilitate her righting herself, in rather marked contrast with the efforts of an overturned *T. denticulata* or a *Gopherus polyphemus*.

Testudo denticulata Linnaeus

The female Red-footed Tortoise described below was secured in February, 1952, and the male a month later. The female possessed an elongate laterally compressed shell, while that of the male was rounder and rather flattened and resembled *Gopherus* in this respect. The plastron of the female was deceivingly concave, and I at first believed her to be a male. A few days after her arrival, I noted that she was not eating, and was acting generally phlegmatic, so I examined her and found an egg in the cloaca. She was at last induced to expel two large spherical eggs, the second of which she stepped on and broke, after several hours of keeping her warm via hot-water bottles and with the use of wet towels.

Another habit of the female *denticulata* that may or may not have been connected with the above incident was a peculiar sensitivity around the posterior edge of the carapace. Whenever anything happened to come in contact with this part of the shell, the tortoise would begin to rotate convulsively, all the while pressing backwards against the offending object. A number of objects could cause this reaction—my shoe, the shell of the male *denticulata*, or a branch of the *Pittosporum tobira* mentioned above, among others. Nevertheless, if the tortoise was not standing, no reaction could be effected.

Occasionally the male *denticulata* would court the female by bumping her with his shell. I never observed copulation. When I introduced a large male *Gopherus agassizi* into the enclosure during some exceptionally warm weather in January, 1953, the male *denticulata* attacked him most viciously, although he was inferior in size to the Desert Tortoise.

The Red-footed Tortoise would bite the shell and limbs of the *G. agassizi* and butt him smartly. Oddly enough, the latter did not retaliate the attacks, probably because of the time of the year.

Testudo gigantea Schweigger

One of the two infant Aldabra Giant Tortoises, the subject of an earlier note, died recently, after having made splendid gains in size and weight. The surviving *gigantea* has increased from a weight of 1¾ pounds and a carapace length of 5⅝ inches on January 30, 1953, to a weight of 2¾ pounds and a length of seven inches on October 12, 1953. It is very fond of tomatoes and lettuce, but is disinclined to accept fruit of any sort or watermelon. It will also eat bread soaked in water. The dead specimen would take ground meat greedily, but this one will not touch it. The latter's upper mandible is becoming very hooked. There was a marked difference in the shape of the two Aldabra Giant Tortoises' shells, the dead one's carapace being less sharply arched and rounder laterally; it also had larger and more robust limbs. The white growth marks at the seams of the laminae were always in evidence, fading out and then brightening up with fair regularity.

On several occasions one or the other *gigantea* was seen to approach one of the larger tortoises from the rear, and with greatly out-stretched neck to scrutinize the larger reptile's posterior shell area. This action would terminate abruptly by the *gigantea's* withdrawing its head and neck with a loud hiss and retreating rapidly to a far corner of the enclosure. I imagine that these violent reactions of apparent fear are inherent, inasmuch as adult *gigantea* could demolish young, incompletely ossified tortoises such as these, by merely stepping on them.

Gopherus agassizi (Cooper)

An adult female Desert Tortoise was secured on May 1, 1953.

She is of special interest, as the posterior lobe of her plastron is slightly movable. Gadow, in referring to *Testudo ibera,* mentions that, "The posterior lobe of the plastron develops with age a transverse ligamentous hinge, and is thus rendered slightly movable, especially the females." I have never found any reference to this condition occurring in *Gopherus.* That this female *agassizi* is old is evident from the much worn carapace and her quite large size (11 1/8 inches).

Another point of interest about this specimen is the presence of integumentary glands on the lower jaw. Smith and Brown record them in *G. berlandieri,* and Carr in *G. polyphemus.* Grant refers to these glands in *agassizi,* and I am inclined to infer that he regarded them as restricted to males. This is interesting, as in my own experience only males of the genus have these glands, with the above noted exception, which seems to be a secondary sexual characteristic, and which I have never observed in the genus *Testudo.* Yet there is little doubt about the sex of this specimen. Copulation was observed in early May, 1953 with a large male *agassizi.* In late June and early July three large eggs were found lying in the enclosure.

Subsequently she began digging a nest on several occasions in the same spot, but never penetrated deeply enough to lay. The method of digging was somewhat different from that recorded by other observers. This tortoise started the digging with the front limbs, using them to get through the grass and hard upper crust. Later she reverted to the more conventional style of chelonian nest-digging by using her hind feet. After

copulation she became very aggressive and would attack the other inmates of the enclosure without warning. She was especially belligerent toward the male *agassizi* with which she had copulated, following him about and butting him. He made no attempt to retaliate the attacks. This belligerent attitude was maintained until shortly after the nesting operations were begun. Since the nesting activities were abandoned, the female *agassizi* has been listless, refusing to eat and being content to lie in the sun in the mornings and late afternoons.

Gopherus polyphemus (Daudin)

One large adult male and one half-grown male Gopher Tortoise were received early in August, 1953, from Silver Springs, Floria.

A pecularity that I have noticed with this species is the elevated position of the head when basking in the sun. This is in marked contrast with my specimens of *G. berlandieri,* which only occasionally assume this position, and *G. agassizi,* which I have never seen with elevated head while basking. The latter two species usually bask with the head resting on the anterior projection of the plastron, or even hanging over the side thereof. All in all, *G. agassizi* and *G. berlandieri* impress me as being more nearly alike than *polyphemus,* and I was much interested in the suggestion by Woodbury that there is a possibility that the former two are merely subspecies rather than valid species.

On one occasion only did I see the large male *polyphemus* rapidly nod his head to the female *G. agassizi.* She did not respond. The movement was well executed and more erratic than that of *G. agassizi.*

I would like to express my indebtedness to Dr. Doris M. Cochran for bibliographic aid.

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416 SOUTH BIRCH STREET, SANTA ANA, CALIFORNIA

AGRICULTURE AND APPLIED SCIENCE LIBRARY MAY 6 1954 MANHATTAN KANSAS

AGGRESSIVE BEHAVIOR IN *PHRYNOSOMA*.—On November 1, 1952, Dr. William H. Brown of the University of Arizona collected two specimens of the desert horned lizard, *Phrynosoma p. platyrhinos*, in the White Tank Mountains, Yuma County, Arizona. The larger of these, an adult male, has continued to exhibit, from the time of its capture, what may be interpreted as aggressive behavior, and a degree of horned-lizard ferocity apparently as yet unrecorded in this species.

On November 12, this adult lizard put on its full demonstration as recorded here, notwithstanding the fact that it was under the less favorable immediate conditions of a cool cement surface in the shade (no shelter available) and with a body temperature (cloacal) of 26° C., which is more than 10° C. below the ecritic mean for this species; time: 1:00 to 1:30 P.M. At the approach of a finger or other object the lizard opened its mouth, hissed, stood high with all four legs upright, arched its flattened body to one side or the other, swayed the whole body back and forth rhythmically on its erect legs, and then lunged forward and nipped at the extended object. It was not observed to bite hard nor to attempt to hang on to the object attacked. Its nipping appeared to be bluff, as did, in fact, the entire behaviorism. Under the influence of great excitement it often leaped and lunged forward until reaching the finger or other object up to 10 inches away. Its high-legged, fore-aft swaying, flattened lateral display, and open-mouthed hissing were continually attendant.

In addition to these unusual actions for a horned lizard, it reacted especially characteristically, and remarkably, to a finger or object extended towards it directly from the rear. When the approaching object was approximately 4 to 6 inches distant from its tail, it quickly flipped around sideways in *mid-air* in a single motion, landing in the same spot as before and pointing in the opposite direction, thus having laterally turned completely through 180 degrees. Now facing the object, it attacked it, as described above. The agility of this reorientation through 180 degrees while in mid-air and at a body temperature of 26° C., appears to us remarkable. When the lizard was approached from the side it often oriented in a single movement through 90 degrees. When the finger was moved steadily and rapidly through a circle around and above the animal, its stereotyped reactions resolved into a weaving, tilting motion of the body from side to side as the finger went around, the animal's feet remaining motionless.

We record the above reactions of this male as they are of more than usual interest, and seem to us to be unreported thus far in this species (The Milnes report somewhat similar behavior, however, in *P. douglassi hernandesi* and *P. cornutum*, *cf.* Amer. Midl. Nat., 1950, vol. 44, p. 723.) The repetition and reaction involved indicate the behavior to be stereotyped. In addition, it involved lateral display posturing and the bluff of defensive behavior. It is accordingly considered to be stereotyped male aggressive behavior that is common to the vertebrate series.—Charles H. Lowe, Jr. and William H. Woodin, III, University of Arizona, and the Arizona-Sonora Desert Museum, Tucson.

Study of Reptile Dens*

By ANGUS M. WOODBURY

The collared lizard, *Crotaphytus collaris,* lying on an uptilted flat stone that caught the rays of the May morning sun, was suddenly startled by my approach and ran a few yards to avoid the disturbance. The lizard, finding that it was not pursued, soon settled down on another rock, similarly exposed to the sun, flattened its body against the warm surface so that its back was exposed to the slanting rays of the sunshine.

Two hours later in the day, another lizard was encountered. But this one was not sunning itself. It was out foraging and when disturbed, it did not stop and hunt a warm rock to sun itself; it ran so far and so fast that I lost sight of it.

These two examples illustrate two different behavior patterns. The first example was seeking heat, the second, food. Both behavior patterns were interrupted by my presence but the reaction was different in each case. The reaction when disturbed represents a third type of behavior pattern. The responses that differed in the two cases show how one behavior pattern may be modified by another. The resultant interactions of such behavior patterns on one another are much in need of study.

The behavior patterns of seeking for heat, seeking for food or fear of an enemy are only a few of the many that could be investigated. Additional patterns could easily include such things as avoiding excessive heat, avoiding excessive cold, seeking mates, courtship, the mating process, egg-laying process, daily wanderings, winter hibernation, summer activity and possibly many others.

These examples raise many questions that point the way to further research in herpetology. It is well known that reptiles in general are much more numerous in the tropics than in the temperate or polar regions. In fact, there appears to be a gradual decline in numbers of species in passing poleward from the tropics. The question of why this is so leads to many problems.

Reptiles and amphibians are cold-blooded or ectothermic animals, by which we mean that they seek heat directly from the environment instead of eating food and producing heat from chemical energy generated within the body as do the warm-blooded animals. This is a key to a great deal of behavior that sets them apart from the endotherms.

Ectotherms in general must seek heat from the environment on the same principle as seeking of shelter, of mates or other necessities of life that may be difficult to get. The endotherms have combined heat-seeking with food-seeking and get both in one operation. It takes much more food, however, to supply an endotherm than an ectotherm and much more work must be done in order to get it. The whole general behavior pattern of ectotherms in general and reptiles in particular, is very different from the endothermic birds and mammals.

The reptiles must spend a great deal of their time and energy in trying to find suitable temperature conditions. The search for heat and the avoidance of excesses requires a great deal of the energy of those that live in temperate regions where there are great changes in temperature from time to time. Thus if they are caught out in a cold storm and become so numbed it is difficult for them to seek shelter, there is great danger of perishing. There may be some exceptions to this but it is the

general pattern. In such a condition, it is not only difficult to seek shelter but also food, mates or other activities.

Problems of temperature relations of reptiles have been much studied by such workers as R. B. Cowles, Charles M. Bogert, Edwin Colbert, Lamont C. Cole, Walter Mosauer, Simon Rodbard, D. L. Gunn, Angus M. Woodbury, Ross Hardy and many others. In general, it appears that the most suitable temperature for reptilian activity lies approximately between 80° and 100° F. (27°-38° C.). This is body temperature, not air or soil temperature although, of course, there is a close correlation, usually lagging behind that of the soil and to a lesser extent that of the air.

The diurnal and seasonal changes in temperature make it difficult for reptiles or other ectotherms to find environmental conditions suitable to give them the proper amount of heat. Rodbard (1948: 413) suggested that the reptiles changed their physiological conditions with changes in the climatic conditions and that there was a sequence of speeding up metabolic activity with increasing temperature and declining activity with declining temperature. This sort of cyclical fluctuation is, however, greatly modified by behavior patterns as Woodbury and Hardy (1948: 145), Cowles and Bogert (1944: 265) and others have shown. The pattern operates approximately as follows: When the nights are cool or cold and the days warm, reptiles usually emerge in the early morning sunshine to get heat to raise their temperature to the comfortable level. Once this is achieved, they go about their ordinary routine activities and carry out any other behavior pattern that is necessary to their well being.

If, however, anything interferes with this comfortable temperature, such as excessive sunshine that warms the ground too much or their body temperatures rise too high or if the reverse takes place and a cloud obscures the sunshine, a cold wind or storm reduces the temperature too low, then any of these behavior patterns that have been depending upon comfortable temperatures may be upset and a different pattern will be invoked that will send the lizard in the direction of shelter.

There is generally a daily cycle of activities that runs something like this. The reptile emerges in the morning, warms itself to the comfortable temperature, goes about its home range hunting for food until it is satisfied, hunts shade or shelter in the middle of the day, sometimes emerges again in the late afternoon in search of food if hungry, then hunts for shelter for the night where it remains until the next morning. These daily patterns are usually not exact duplicates of one another, but they gradually change as the season advances. In the early spring, they may come out only during the middle of the day but as summer approaches, they emerge earlier and earlier in the morning and are hidden for longer periods during the day.

These changes in the daily cycle gradually weave themselves into a seasonal behavior pattern. Sometime in late summer or fall, reptiles generally find shelter for the winter and remain in a dormant condition until spring when they emerge. The length of this winter hibernation varies a great deal in different species and in different latitudes, presumably decreasing in regions with warmer winters until the winter aspect of the pattern is lost. In the regions where my studies were made, the underground hibernation period lasts six or seven months. There are, of course, a great many variations and exceptions to this general pattern, especially in the details of time and place and the various steps that occur.

This annual pattern is relatively well known in certain species, but in a great majority, it has not been well studied. There is much room for work to discover this series of behavior patterns that make up the annual cycle. In a general way, with many exceptions, it runs something as described in the temperate zone with cold winters.

The conditions under which reptiles hibernate vary a great deal in different groups. Among the lizards, the times and periods of hibernation are not well studied, especially among different species. In the writer's experience, many lizards have been observed in hibernation. The few known cases suggest that they usually hibernate singly in rodent burrows, natural crevices in the ground or that they perhaps even burrow into sand banks. Even though this aspect of lizard behavior is being studied by Fitch and others, it still needs a great deal of attention on the part of research investigators.

Many of the snakes and tortoises are known to congregate in groups for hibernation. Tortoises can dig their own burrows and make long winter tunnels in which to pass the winter. The studies of Woodbury and Hardy (1948) suggest that they possess a feeble social attraction which draws tortoises into winter holes (dens) where other tortoises have already congregated. Much still remains to be done in the study of tortoises to find out how one behavior pattern affects another and how the micro-environmental factors modify or control all of these behavior patterns.

Snakes have no or little equipment for digging, and hence they do not make their own winter burrows. Instead they must depend upon natural cavities or openings in the ground where they can find underground safety. Snakes ordinarily find suitable places in such openings as those left by dried-up springs, crevices in lava flows, open spaces in slide rocks or gravel beds, prairie dog burrows, openings in land slides, crevices left by faulting or twisting of rocks, tumbled-down buildings, rock-walls against a bank, sheltered open spaces under houses and many other such places.

Some snake dens are very old and seem to have been occupied for ages. Others are known to be new and to have been developed in very recent times, perhaps within only a few years. How such dens develop is, of course, not well known and needs much investigation.

Some light is thrown upon snake dens, however, via the work done at a Tooele County den by Woodbury, *et al*. After studying population samples, over a period of ten years or more, it was found that the great bulk of the winter population of the den consisted of adult snakes, very few immature snakes being found therein. Apparently the young snakes are not born at the den and do not know their way to it. They must, therefore, hibernate at other places and only gradually find their way to the den as they become older. The largest groups of the age classes are found at about 4 to 5 years of age. They appear, therefore, to come into the den for winter when they are becoming sexually mature.

Much more research is needed to find out how and why they come to these winter dens but for a working hypothesis, it might be assumed that their well-known habit of trailing one another enables them to follow other snakes that know their way to the den. Perhaps this is the reason that snakes aggregate and lizards do not.

When snakes emerge from the den in the spring, they scatter out over surrounding range for summer and return again in the fall. Some are doubtless lost during the summer and do not return but it is not known

whether some of them leave and go to other dens. However, the work of Woodbury at the Tooele County den over a period of 10 or 12 years amply substantiates the theory that the great majority of the snakes return to the same place.

How far they radiate for the summer is not known. Information of this nature could of course be obtained by marking the snakes, releasing them for the summer and following them around the summer range. Some light on this problem should be forthcoming soon from the studies of Fitch in Kansas but much more work needs to be done in regions where snakes concentrate in great aggregations for winter. It seems axiomatic that they would have to disperse far enough in the summer to provide adequate range for the population.

If the space underground is adequate it seems that the numbers that congregate at the den will be determined largely by the size of the range and the amount of food and other necessities of life that can be reached during the summer from the den as a center for winter. This type of population concentration in winter dens seems to indicate that snakes would be irregularly distributed over the range, being greatly concentrated in the area surrounding a suitable winter den and being absent in such areas where no such dens exist. This seems to be in decided contrast to the distribution of lizards which find wintering areas almost everywhere.

It also implies that snakes have developed a sort of migratory behavior, in which they concentrate in the dens for winter and move out onto the summer range, from which they return again to the dens for winter.

This leads back again to the main problem of behavior patterns in relation to temperature comfort. The temperature conditions of the hibernating quarters are not well known. A few specimens that have been captured immediately upon coming to the surface in the spring have a known temperature slightly under 50° F. Presumably they go into hibernation in the fall when underground temperatures are more comfortable than the cool nights of fall and they do not come out again until warm weather in the spring arrives. If they get underground far enough, they may not be much affected by surface temperatures but if they are within a few feet of the surface, it seems entirely possible that the ground temperatures around them would be gradually lowered until the warm air of spring would have a higher temperature than that of their underground quarters.

This raises the question of whether there are different levels of comfort between summer and winter, *i.e.*, is the winter comfortable temperature so low that they will not waste energy through rapid metabolism when they are dormant?

Dixon Woodbury (Master's Thesis Manuscript, U. of U.) showed that the wandering garter snake *Thamnophis e. vagrans* used 2.8 times as much oxygen at 32° C. as at 20° C. According to his figures, such a snake could hibernate at 10° C. for several months on a supply of energy contained in a few grams of fat. It would seem, therefore, that the optimum conditions for hibernation would be at low temperatures, where metabolism was slowed to a minimum without damage or with a minimum of damage.

The physiological changes that take place within a reptile at the time of hibernation and at the time of emergence are much in need of further

study. Presumably digestion and defecation are stopped and kidney excretion is reduced to a low minimum. The heart beat is very slow, breathing much reduced, circulation and breathing scarcely noticeable.

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* Read at the joint meeting of the Herpetologists League and the American Society of Ichthyology and Herpetology, held under the auspices of the Pacific Division of the American Association for the Advancement of Science, in a symposium on "Some Major Research Needs in Ichthyology and Herpetology," at Santa Barbara, California, June 17, 1953.

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SALT LAKE CITY, UTAH

Additional Note on the Genus *Hypsiglena* With a Description of a New Subspecies

By WILMER W. TANNER

Recent collections made in southern Utah (Kane and Washington Counties) and a re-examination of the specimens in the Grand Canyon National Park collections have indicated the limits of a zone of intergradation between *Hypsiglena torquata ochrorhyncha* and *H. t. deserticola.* Although this zone is not as yet clearly defined along the southern border, the northern border is approximately from the Beaver Dam Mountains of southwestern Utah eastward along the Utah-Arizona line to Kane County and then north and east to include the area south and east of the Vermillion Cliffs.

In most specimens seen from this area the scale counts, ventrals, and ventral-caudal totals are well within the limits of *deserticola.* In the nape pattern, however, nearly all of the specimens from Kane County and a few from Washington County have the nape spots united or describing various patterns more closely resembling those of specimens from central and southern Arizona than of *deserticola* to the north and west. It is likely that intergradation may occur in much of the area between the Utah-Arizona state boundary and the Grand Canyon of the Colorado River, generally known as the Arizona Strip.

A specimen collected by A. H. Barnum four miles east of Torrey, Wayne County, Utah, is a typical *lorealis.* This record extends the range approximately 70 miles south and indicates a possible intergradation of *lorealis* with the *ochrorhyncha-deserticola* population in eastern Garfield County or northeastern Kane County.

In my original study of the genus *Hypsiglena* (1946), I reluctantly included the specimens from the Isla Partida, Baja California, in the subspecies *ochrorhyncha* and referred to them as intergrades. During the past summer while at the California Academy of Sciences, Mr. Joseph R. Slevin kindly permitted me to re-examine the excellent *Hypsiglena* collection from Baja California; also, while at Stanford University, Mr. Jay M. Savage graciously permitted the examination of a few specimens (not yet reported in print) from the peninsula and islands in the Gulf of California. Although no additional specimens are available from the Isla Partida, the two at hand are very distinct when compared with specimens of *venusta* from the peninsula as well as specimens from other islands, and should be known as

Hypsiglena torquata gularis subsp. nov.

The Partida Night Snake

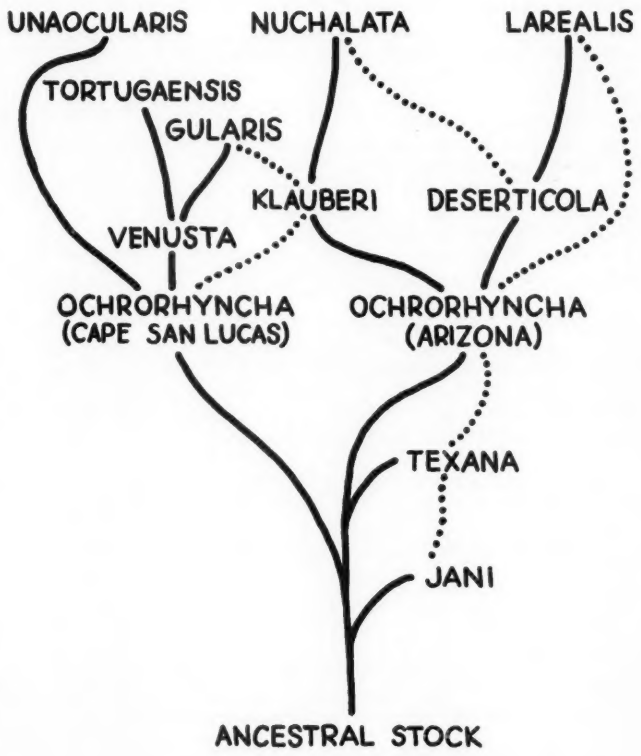
Type. An adult female, California Academy of Science 51009, taken at Isla Partida * 28° 53″ north latitude and 113° 3″ west longitude, Baja California, Mexico, by Joseph R. Slevin, on April 22, 1921.

Paratype. California Academy of Science 51010, with the same data as the type.

* This island should not be confused with an island to the south also called Isla Partida. The latter is located a short distance directly north of Isla Espiritu Santo on the eastern edge of the Bay of La Paz. It is approximately 24° 34″ north latitude and 110° 22″ west longitude, Baja California.

Diagnosis. A subspecies of *Hypsiglena torquata* ** closely related to *venusta,* but with large united or alternating dorsal spots; a median nape spot similar in appearance to *deserticola,* but not reaching the parietals as in *klauberi;* one or more pairs of gulars enlarged, in the type appearing as a third pair of caudolateral chinshields; caudals low; tail short, 12-14 per cent of total length.

Description of type. Head of normal size and proportions; eye less than one-half interorbital space; snout blunt, rostral clearly visible from above, head plates normal except for enlarged gulars immediately caudo-



** Although my original views concerning the uniting of *torquata* and *ochrorhyncha* have not changed, the use of *torquata* at this time is primarily for the sake of uniformity (conforming with Schmidt's checklist, 1953) until sufficient data are available to solve the problem.

lateral to the posterior genials. Dorsal scale formula 21-19-17-16, the reduction to 19 rows occurring at the 114th ventral by combination of the third and fourth rows, the second reduction to 17 rows occurring at the 131st ventral by combination of the fourth and fifth rows. A reduction to 16 rows occurs on the left side by union of the third and fourth rows at the 174th ventral. There are 185 ventrals and 43 caudals. Total length 395 mm., tail 53 mm., ratio of tail to total length .134.

Color pattern of seven longitudinal rows of brownish spots on a grayish ground color. Dorsal row largest, occupying the seven median rows of dorsal scales; lateral rows of spots progressively smaller from dorsal to ventral surfaces. Dorsal spots involving 10-14 scales, several of which are only partly involved. Body with 68 dorsal spots, tail spots not clearly discernible. Nape with three large spots; dorsal spot 9 scales long, 7 across, and 2 scales caudad to parietals, a narrow anterior end 3½ scales long and 1-2 scales wide, posterior end with a central concavity. Lateral spots continuous to eye, in narrow contact with medial spot on left side; dorsum of head without spots; lower labials flecked and with a spot on first and second equally divided by the suture; gulars and chinshields finely flecked; ventrals immaculate.

Remarks. Paratype very similar in all details to the type; ventrals 183; caudals 43; median nape spot not in contact with either lateral spot, and also two scales posterior to the parietals.

The subspecies *gularis* is readily distinguished from *venusta* and *tortugaensis* by means of the position and shape of the median nape spot, by the small dark spot on the first and second infralabials, by the enlarged gulars, and by the reduced number of subcaudal plates. From *venusta* it is further distinguished by not having the dorsal spots separated along the dorsal median line by a lighter stripe. The position of the median nape spot two scales posterior to the parietals and the reduced caudals are characteristics of *klauberi*. However, *gularis* is readily separated from the latter by the lateral nape spots continuing uninterrupted to the eye and by the increased spots in the median row. Such characters as the shape and greatest width of the median nape spot, enlarged gulars, and short tail, will distinguish *gularis* from *klauberi, venusta* and *tortugaensis*.

BRIGHAM YOUNG UNIVERSITY, PROVO, UTAH

Appendicular Skeleton of the Ambystomidae

By PAUL S. STOKELY* and PAUL A. HOLLE**

The need for comparative studies within each family of the several vertebrate groups is apparent when one realizes that evolution has many patterns and is different, *e.g.*, in the Apoda, Caudata and Salientia, the three living orders of amphibians. The material furnishing the basis for the present report on the appendicular skeleton of the Ambystomidae is the same series of twenty-four cleared and stained specimens which was studied by Stokely and Holle (1953) for their account of vertebral variation in the Ambystomidae. This series included seven species of the genus *Ambystoma*, two subspecies of *Ambystoma tigrinum* and one species each of the general *Dicamptodon* and *Rhyacotriton*. Fifteen specimens were furnished through the courtesy of Mr. K. P. Schmidt of the Chicago Natural History Museum (CNHM) and the rest were from the collections of the University of Notre Dame (UND). The figures were done by the junior author and show only bone except for small areas of calcified cartilage which are indicated by stippling.

In the Ambystomidae, as in all urodele amphibians, the dermal bones (clavicles, etc.) of the pectoral girdle are completely lost and the shoulder girdle, largely of cartilage, shows only one ossification. This is in the neighborhood of the glenoid cavity and represents the scapula while the coracoid and precoracoid regions remain cartilaginous. The scapula was observed to be fairly constant in design for the several genera. In each of the specimens examined of the genus *Ambystoma*, there was present a supracoracoid foramen to which a fine suture extended from the glenoid cavity. Neither supracoracoid foramen nor suture was present in the specimens examined belonging to the other two genera, *Dicamptodon* and *Rhyacotriton* (see Pl. 1). In the series of ten specimens of *Ambystoma texanum* it was noted that the path of ossification appears to be distad to the glenoid cavity along a path generally defined by the suture. In Figure 8 the foramen is peripherally located and enclosed by bone while in Figure 9, which represents a stage of less extensive ossification, the foramen is only partially surrounded by bone.

The forelimb is comprised of the usual elements found in the less specialized tetrapod limb, namely the humerus, radius, ulna, carpals, metacarpals and phalanges. Both proximal and distal ends of the humerus, radius and ulna exhibited various degrees of ossification. Only the proximal ends of the humerus and ulna consistently showed extensive ossification.

The carpal bones in each of the specimens examined comprise three rows generally arranged horizontal to the long axis of the limb. The radiale, intermedium and ulnare form the proximal row. The middle row consists of a prepollex and centralium, the distal row of three basals. (Although four digits characterize the forelimb, only three basals are present—the result of the fusion of the first and second according to Francis, 1934.) It was observed that the intermedium, centralium and ulnare were usually the most completely ossified carpals while the prepol-

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*Assistant Professor of Biology, University of Notre Dame, Notre Dame, Indiana.

**Instructor in Biology, University of New Hampshire, Durham, N.H.

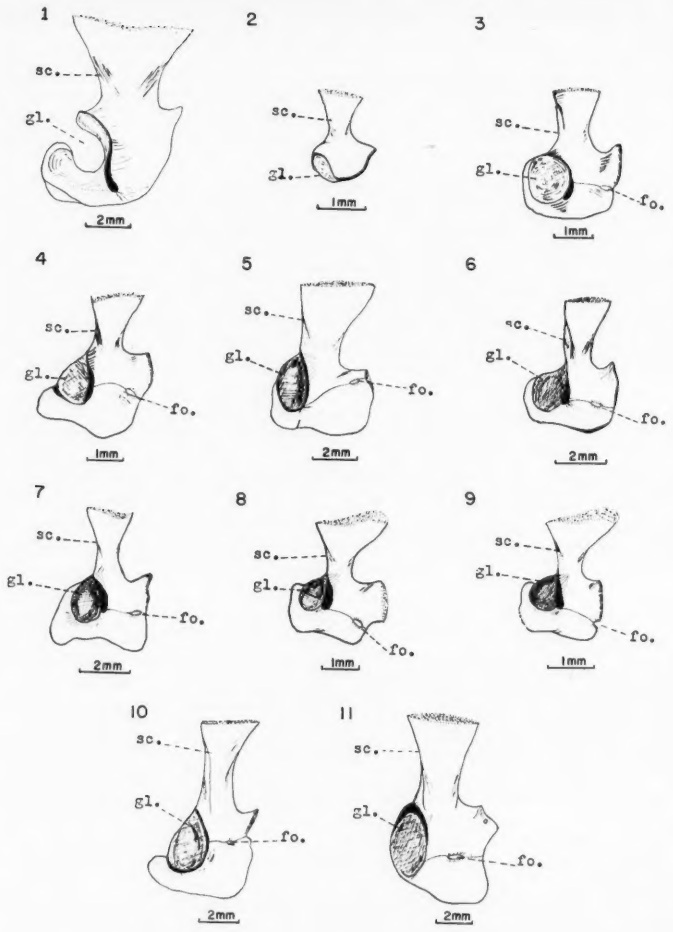


Plate 1. Lateral views of right scapulae. 1, *Dicamptodon ensatus* (CNHM 31814); 2, *Rhyacotriton olympicus* (CNHM 27113); 3, *Ambystoma jeffersonianum* (CNHM 11076); 4, *Ambystoma macrodactylum* (CNHM 6970); 5, *Ambystoma maculatum* (CNHM 4839); 6, *Ambystoma opacum* (CNHM 8510); 7, *Ambystoma talpoideum* (CNHM 4845); 8, *Ambystoma texanum* (CNHM 8015); 9, *Ambystoma texanum* (UND 592); 10, *Ambystoma tigrinum tigrinum* (CNHM 42114); 11, *Ambystoma tigrinum diaboli* (CNHM 53905). Symbols: *fo,* supracoracoid foramen; *gl,* glenoid fossa; *sc,* scapula.

lex and radiale were the least ossified. The most persistently ossified of the three basals was that formed by the fusion of the first and second.

The metacarpals and phalanges of all specimens were ossified and dumb-bell in shape. The metacarpals, one for each digit, were longer than any phalanx. The phalanges of each digit decreased in length distad. The metacarpals and phalanges were capped with cartilage at both ends. The phalangeal formula for the fingers throughout the entire series studied was 2-2-3-2.

Each half of the pelvic girdle of these amphibians is comprised of two major portions: (1) the ilium, a dorso-vertical projection which establishes a cartilaginous connection with the distal end of a sacral rib; and (2) the ventral pubo-ischiac plate formed by the union of an anterior pubis with a posterior ischium.

The ilium is well ossified and its shape quite constant from species to species. It is an elongate bone, slightly broadened at its dorsal tip and its base usually comprises most of the acetabulum.

As has been reported, the pubes appear as a single cartilaginous plate in all species. However, this pubic plate was found to be wholly or partially of calcified cartilage in four of the specimens studied here. Two of these *(Ambystoma tigrinum tigrinum* and *A. t. diaboli)* have the entire pubic plate slightly calcified (Figs. 20-21), whereas another two *(Dicamptodon ensatus* and *Ambystoma maculatum)* have a small calcification center in each half of the pubic plate (Figs. 12 and 16).

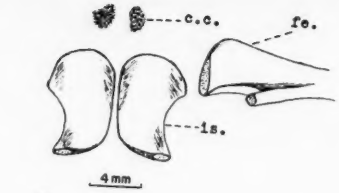
The ischia were ossified completely in every specimen. Their shapes varied somewhat interspecifically but were constant intraspecifically (see Figs. 12-21).

The position of the head of the femur in relation to the pelvic girdle displayed an interesting variation. Those specimens with slightly calcified pubes or calcification centers in the pubes had the proximal end of the femur located lateral to both ischium and pubis. Those specimens in which the cartilage of the pubes was uncalcified had the femur located farther caudad—lateral to the ischium only (see Figs. 12, 16, 20 and 21).

The bones of the hind limb correspond closely in number, arrangement and degree of ossification with their homologues of the forelimb. The proximal ends of the femur, tibia and fibula showed the greatest ossification, but the proximal end of the fibula failed to show the persistently high degree of ossification shown by the ulna.

The degree of ossification of the tarsal bones corresponds closely with the carpals, the centralium, intermedium and fibulare being the most extensively ossified, with the tibiale and the prehallux the least ossified. Although five digits characterize the hind limb, only four basals are present, again as the result of the fusion of the first and second. The basal formed by the fusion of the first and second was always well ossified, whereas the remaining basals were very erratic in this regard.

Each of the five digits possessed a metatarsal which paralleled in shape and relative size the corresponding metacarpal of the forelimb. The phalangeal formula of the toes varied significantly. All specimens examined of the genus *Ambystoma* had a phalangeal formula of 2-2-3-4-2 but the formula for *Dicamptodon ensatus* and *Rhyacotriton olympicus* was found to be 2-2-3-3-2.



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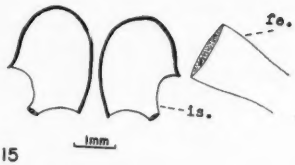

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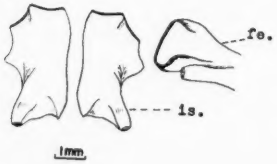

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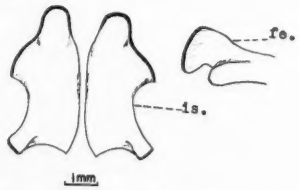

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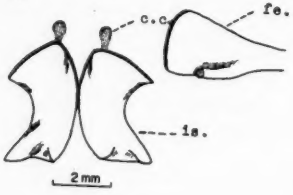

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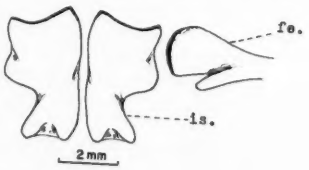

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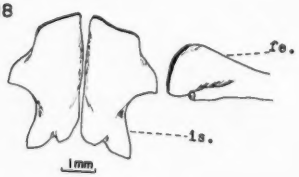

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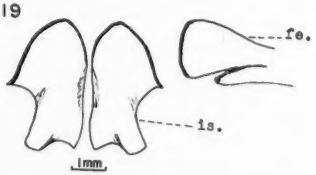

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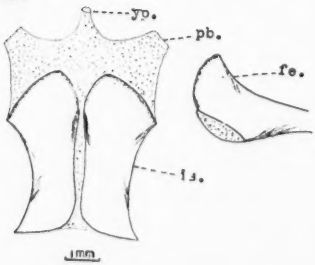

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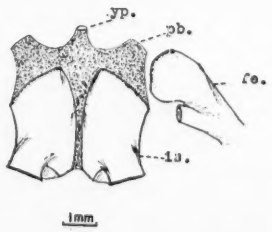

Plate 2. Ventral views of pelves. 12, *Dicamptodon ensatus* (CNHM 31814); 13, *Rhyacotriton olympicus* (CNHM 27113); 14, *Ambystoma jeffersonianum* (CNHM 11076); 15, *Ambystoma macrodactylum* (CNHM 6970); 16, *Ambystoma maculatum* (CNHM 4839); 17, *Ambystoma opacum* (CNHM 8510); 18, *Ambystoma talpoideum* (CNHM 4845); 19, *Ambystoma texanum* (CNHM 8015); 20, *Ambystoma tigrinum tigrinum* (CNHM 42114); 21, *Ambystoma tigrinum diaboli* (CNHM 53905). Symbols: *cc,* calcification center; *is,* ischium; *fe,* proximal end of femur; *pb,* pubis; *yp,* ypsiloid process.

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CONTRIBUTION FROM THE DEPARTMENT OF BIOLOGY, THE UNIVERSITY OF NOTRE DAME, NOTRE DAME, INDIANA

Additional Records and Descriptions of Mexican Frogs of the Genus *Plectrohyla*

By CARLOS B. BUMZAHEM and HOBART M. SMITH

In a collection of amphibians and reptiles from Chiapas, Mexico, forwarded to the University of Illinois Museum of Natural History by Mr. Eizi Matuda, now of Mexico City, Mexico, five species of *Plectrohyla* were found, three of which are new to Mexico. Two have been previously recorded only from Guatemala and one appears to be new. These specimens were collected incidental to other work by Mr. Matuda during five years at his former residence at Finca La Esperanza, District of Soconusco, Chiapas. Unfortunately, no other data are available and since this district contains a wide variety of habitats, the precise area of occurrence of the three newly recorded species is speculative.

Another specimen here reported of this genus, apparently an intergrade between two supposed species, was recently collected by Mr. Thomas C. MacDougall on the top of Cerro Baul, Oaxaca.

In studying this material we have received valuable aid from Dr. L. C. Stuart in making comparisons and determining the taxonomic status of the several forms represented. We are indebted also to Dr. D. F. Hoffmeister for critical perusal of the manuscript.

Plectrohyla guatemalensis Brocchi

A single specimen (UIMNH 33692) is from the Región de Soconusco, Chiapas, Mexico, collected between 1944 and 1949. The specimen is a large gravid female measuring 54 mm. snout to vent. The spine of the pollex is bifid, a character which immediately differentiates it from any other known member of the genus, and the digits have well developed, rounded apical discs. The snout is rounded in outline, the canthus sharp, the lores sloping, and the tympanum rather well hidden, although a slight trace of its outline is discernible upon close examination.* A

* This is not true of a female Guatemalan specimen with which it was compared, which has well defined tympana. However, a male from Guatemala has the tympanum concealed as in ours.

fairly well developed tubercular dermal fold curves backward from the posterior margin of the eye to the origin of the forelimb. The skin of the abdomen and under surface of the thighs is coarsely granular. A well defined but not flaplike inner metatarsal fold is present, but no outer. The finger pads are nearly twice as wide as the tympanum, and the toe pads a little smaller than those on fingers. The upper parts are a bluish slate in color (in alcohol) with scattered dark spotting (apparently a secondary sex character, absent in a Guatemala ♂, present in a Guatemala ♀) and with tiny tubercles.

Previously this species has been recorded only from Guatemala.

Plectrohyla avia Stuart

Two specimens, a male (UIMNH 33690) and a female (UIMNH 33691) are from the Región de Soconusco, Chiapas, Mexico, collected between 1944 and 1949. The male measures 91 mm and the female 68 mm snout to vent. Previously only the single type specimen, from Guatemala, has been recorded.

The spine of the pollex is simple and sharply pointed; the digits have well developed apical discs, about equal in diameter to the vertical diameter of the tympanum. The male has very thick, muscular arms. The skin of the upper surface of the head and hands is finely tuberculate, the remainder of the skin smooth with only a few widely scattered tubercles.

Color of the upperparts (in alcohol) is chocolate, the underparts an immaculate flesh color. The belly and under surface of the thigh are granular; skin of the chest smooth with an indication of a transverse fold; a heavy supratympanic fold merging with the fairly sharp, well defined canthus.

These specimens agree essentially with the original description of *P. avia*. One apparent, but actually non-existent, difference is in the horizontal diameter of the tympanum which in the original description is stated to be slightly less than that of the eye. In the present example the diameter of the tympanum is about two-fifths that of the eye. Dr. L. C. Stuart has kindly advised that the type is the same, and that the printed version is a *lapsus calami* for "less than ½ the eye."

Actual differences do exist, however, in other respects. The prepollex is not at all horny or blackened, although our male is even larger than the type. Furthermore, the fingers are very distinctly webbed (webs to the level of the distal end of the proximal phalanx on 2nd and 4th fingers), whereas *avia* is described as having "a trace of a web between fingers." A subspecific difference may exist, but without further material no reliance can be placed upon the differences now observed.

Plectrohyla sagorum Hartweg

Five specimens (UIMNH 33821-33824) are from the Región de Soconusco, Chiapas, Mexico, collected between 1944 and 1949. These agree closely with previous descriptions, having a sharply pointed snout with a vertical rostral keel; the height of snout a little greater than length; a relatively smooth skin with a few scattered tubercles; and snout to vent measurements varying from 32 mm. to 41 mm.

Plectrohyla matudai brachycephala Taylor X *Plectrohyla matudai matudai* Hartweg

A female (UIMNH 33835), collected in a bromeliad on top of Cerro Baul, Oaxaca, on February 4, 1953, by Mr. Thomas MacDougall,

appears to be intermediate between *brachycephala* and *matudai*, as indicated by the following comparison (characters for *brachycephala* from Taylor, 1949: 16-19).

	brachycephala	*matudai*	UIMNH 33835
tympanum	concealed	usually concealed	weakly evident, least diameter ½ that of finger pads
inner metatarsal fold	strong, elevated (flaplike?)	usually less elevated	flaplike
snout height	greater than length	less than length	greater than length
dorsum	smooth	pustular	smooth
dorsal color (in alcohol)	dark gray or brownish grey	brownish grey	dark grey, nearly black
markings of chin	dark blackish	grey or speckled with brown	light, prominently speckled with dark brown or black
markings of throat	dark blackish	greyish white	yellowish-white, prominently speckled with dark brown or black
markings of belly	strongly pigmented	grey	darkly pigmented
markings under limbs	dark with light marks on underside of tibia	grey	yellowish-white with scattered areas of pigment

These comparisons reveal 2 features agreeing with those of *matudai*, 4 with *brachycephala*, and 3 intermediate. On the whole, the specimen seems closer to *brachycephala*, but it cannot be regarded as typical of either form. Furthermore, the present specimen was collected in an area intermediate geographically between those known to be occupied by *matudai* and *brachycephala*. These facts seem to indicate that the specimen from Cerro Baul is most reasonably interpreted as an intergrade, and that *brachycephala* should, at least until further data are available, be considered a subspecies of *Plectrohyla matudai*.

Plectrohyla matudai matudai Hartweg

Ten specimens (UIMNH 33825-33834) are from the Región de Soconusco, Chiapas, Mexico, collected between 1944 and 1949. These specimens agree with previous descriptions. The snout is rounded or bluntly pointed at tip; height of snout at tip a little less than the length; and dorsal surface strongly pustular. Snout to vent measurements vary from 36 mm to 49 mm, two specimens exceeding the 45 mm maximum

length previously recorded (one a male, 46 mm, the other a female, 49 mm).

Plectrohyla lacertosa, new species

Holotype. UIMNH No. 33693, from the Región de Soconusco, Chiapas, Mexico, collected by Mr. Eizi Matuda, between 1944 and 1949.

Diagnosis. A *Plectrohyla* with short head, a simple truncate spine on pollex; tympanum concealed; skin relatively smooth, with tubercles not prominent except on head; arms enormously hypertrophied in males; upper lips glandular, thickened, slightly pendant; no inner or outer metatarsal folds; an inner but no outer metatarsal tubercle; a single large vomerine tooth on either side; teeth on upper jaw large, 30-31 in number; no vocal slits; groups of vomerine teeth separated widely, closer to choanae than each other; height of snout at tip a little greater than length of snout; canthus angular, coming to a dull point at snout.

Description of Holotype. Head round in outline; canthus angular but rounded, coming to a dull point; height of snout equal to or slightly greater than length of snout; upper lips swollen, slightly pendant, jowl-like; a single very large vomerine tooth on an elevation on either side halfway between choanae and midline, and slightly posterior to level of middle of choanae; vomerine teeth directed backwards, lying close to roof of mouth; 30-31 teeth on either side of upper jaw.

A male with extraordinarily well developed arms, enclosed in loose skin forming a free fringe or flap extending along anterior edge of arm from wrist to midline of chest; conspicuous folds of skin at elbow and wrist; upper arm about as thick as long. Inner edge of prepollex and pollex and tip of prepollex conspicuously pigmented, spine of prepollex truncate, all bony. Discs on fingers large, that of fourth finger 2.5 mm. wide; that of first finger 1 mm. less; no trace of a web between fingers.

Legs rather short, tibiotarsal joint reaching beyond eye nearly to snout; webbing formula for toes 1-2, 1-3, 2-3, 3-1; discs on feet slightly smaller than those on fingers.

Snout-vent length, 47 mm; head width at angle of jaw, 15.5 mm; anus to heel 45 mm; heel to tip of digit IV, 38 mm.

Skin of back generally smooth with indistinct tubercles on rump and upper surface of legs; more distinct tubercles on head; abdomen and ventral surface of thighs granular.

The skin of this specimen is loose generally and thrown into a number of folds especially in the area between the arms. A real supratympanic fold is not evident, probably due to the loose condition of the skin; however, a groove is evident running from the posterior corner of the eye and curving downward toward the middle of the insertion of the forearm.

The color of the upper parts (in alcohol) is a uniform dark grey; under parts lighter, under surface of legs more heavily pigmented than that of head and body.

Comparisons. P. lacertosa does not seem especially closely related to any species formerly described in the genus. It is unique in having a single pair of vomerine teeth, no metatarsal folds whatsoever, glandular lips; it shares the reduced number of teeth with *cotzicensis*, which also approaches closest in reduction of vomerine teeth (2 on each side); the greatly hypertrophied forearms are approached but not matched by *quecchi*; the truncate prepollex is matched only in *cotzicensis* and is ap-

proached somewhat in *quecchi*; and the absence of vocal slits is matched only in *cotzicensis, guatemalensis* and *avia.* The combination of a completely bony and truncate prepollex is unique. Clearly *cotzicensis* appears to possess more characters in common with *lacertosa* than any other known species, and some of those characters are of major importance, but the relationship can scarcely be close.

The prepollex of *cotzicensis*, which we have examined in a single full-grown example of each sex, is a truncate structure unique, however, in having a cartilaginous instead of bony tip (about 1/2 to 1/3 the length of the prepollex). The prepollex of *lacertosa* is entirely bony, but similarly truncate. All other species (of which at least one example each

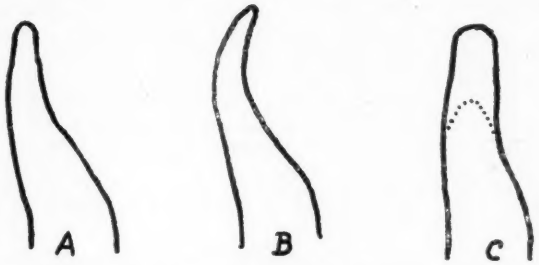

Fig. 1. Prepollex of several species of *Plectrohyla.* A, *P. quecchi,* MZUM 89091; B. *P. ixil,* MZUM 89093, typical of the prepollex of species other than *quecchi, lacertosa* and *cotzicensis*; C, *P. lacertosa,* UIMNH 33693 (dotted line indicates approximate line of separation of cartilaginous tip and bony base in *P. cotzicensis*).

has been examined) have a sharply pointed prepollex, except in *quecchi,* in which the prepollex is bluntly pointed—a condition intermediate between that of *lacertosa* (and *cotzicensis*) and the other species, but clearly more like the latter.

Remarks. Formerly three species of *Plectrohyla* were recorded from Mexico. These are *sagorum* Hartweg, *matudai* Hartweg, and *brachycephala* Taylor. The discovery of the two Guatemalan forms and the species described above increases that number to six forms, two of which are now placed in a single species. Only three species now known do not occur in Mexico: *quecchi, ixil* and *cotzicensis,* all of Guatemala. The nine forms now known may be contrasted as in the following key.

1. Prepollex bifid ..... *guatemalensis*
   Prepollex simple 2
2. No metatarsal folds whatsoever; prepollex truncate, wholly bony; a single vomerine tooth on each side; upper lips swollen, glandular ..... *lacertosa*
   At least an inner metatarsal fold; prepollex pointed or, if truncate, distal fifth or more cartilaginous; 2 or more vomerine teeth on each side; upper lips normal, not swollen or glandular 3

3. Only 2 vomerine teeth on each side; prepollex truncate, distal tip cartilaginous; maxillary teeth very few, 26-30; an outer as well as inner metatarsal fold; no vocal slits....*cotzicensis*
   Three or more vomerine teeth on each side; prepollex pointed; maxillary teeth 36 or more; no outer metatarsal fold; vocal slits present or not..... 4
4. Size large, reaching 91 mm.; no vocal slits; tympanum clearly defined; snout rounded, not keeled; fingers distinctly webbed....*avia*
   Size smaller, not known to exceed 49 mm.; vocal slits present; tympanum clearly defined or not; snout rounded or not; fingers webbed or not..... 5
5. A vertical rostral keel..... 6
   No rostral keel..... 7
6. Forelegs greatly enlarged; prepollex bluntly pointed; skin tubercular at least on head; 48-53 teeth on each side of upper jaw .....*quecchi*
   Forelegs little enlarged; prepollex sharply pointed; skin relatively smooth; 36-45 teeth on each side of upper jaw.....*sagorum*
7. Forelegs strongly developed; skin smooth above; snout pointed; tympanum usually clearly evident.....*ixil*
   Forelegs little enlarged; skin smooth or not; snout rounded; tympanum concealed usually..... 8
8. Throat and belly spotted and stippled with with black; inner metatarsal fold strong, flaplike .....*matudai brachycephala*
   Throat and belly light, unspotted; inner metatarsal fold not flaplike.....*matudai matudai*

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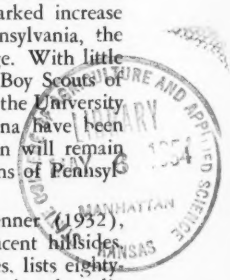
An Annotated List of the Reptiles and Amphibians of the Unami Valley, Pennsylvania

By ROBERT G. HUDSON

During the years 1938 to 1942, various persons interested in the herpetofauna of southeastern Pennsylvania collected in Montgomery and Bucks counties in a region known as the Unami Valley. As specimens accumulated they were incorporated into the temporary study collection maintained at the Philadelphia Zoological Garden but were transferred to the private collection of Richard M. Knox who had intended to prepare a study upon them. When he entered the Armed Forces in 1950, Knox gave me the specimens with the request that I prepare a report upon the area. A total of 183 specimens, representing thirty-one of the seventy-four species known to occur in Pennsylvania, have been examined. These include 10 new county records for the extensive collection of Pennsylvania study material in the Carnegie Museum, where my specimens, with few exceptions, have been deposited.

The Unami Valley is situated approximately twenty-five miles northwest of Philadelphia and extends in a northeast-southwest direction through Marlboro Township, Montgomery County, and for a short distance through Milford Township, Bucks County. The Valley, approximately five miles in length, has its origin in the vicinity of Finland, Bucks County, and terminates near Perkiomenville, Montgomery County. The area lies within the major topographic type, Piedmont Province, subdivision Triassic lowland section as summarized by Ashley (1933). Ashley diagnoses the Piedmont Province as "A broad belt underlain by Triassic red beds with many protruding masses of diabase (trap) . . . here and there rise knobs, ridges, and conical hills formed by trap rocks or by harder sandstones." Ridges, almost precipitous in some places, rise to an elevation of 500 feet on each side and limit the Valley to an approximate average width of one mile; the lowest elevation is 300 feet. The approximate elevations are taken from the Quakertown Quadrangle of the United States Geological Survey. The Unami Creek, formerly East Swamp Creek, drains the entire valley and is a tributary of the Perkiomen Creek which eventually enters the Schuylkill River.

Almost all of the land beyond the ridges is improved farm land. What with farming in adjacent regions and the recent marked increase in industrial and residential building in southeastern Pennsylvania, the area under consideration represents a natural wild life refuge. With little exception, most of the valley is owned by councils of The Boy Scouts of America (Camp Delmont and Hart Scout Reservation), and the University of Pennsylvania, under whose auspices the flora and fauna have been relatively little disturbed. It is to be hoped that the region will remain one where many of the less common reptiles and amphibians of Pennsylvania can be observed and collected.



The Oak-Hickory Type of forest, as designated by Benner (1932), is well represented throughout the Valley and on the adjacent hillsides. A survey of Camp Delmont, which has an area of 430 acres, lists eighty-two species of trees and shrubs. White oak, red oak, black oak, tulip poplar, black walnut, shagbark and mockernut hickory, black birch, and red cedar are well represented.

It should be noted that *Rana catesbeiana* and *Eurycea l. longicauda* are not included in the listing below. *Rana catesbeiana* may be absent because of lack of suitable breeding areas. *Eurycea l. longicauda* probably is omitted only because of a failure to collect it, for it occurs in neighboring areas. The turtles *Sternotherus odoratus* and *Chelydra s. serpentina* presumably inhabit Unami Creek, and their presence probably could be demonstrated if a turtle trapping campaign were instituted.

I have contributed very little to the actual field work and I am indebted to Roger Conant of the Philadelphia Zoo, Richard M. Knox, various members of the former Junior Zoological Society of Philadelphia, and the nature staffs of the Boy Scout camps situated in the Valley, all of whom have participated in some measure toward assembling the material.

ACCOUNT OF SPECIES

Diemictylus viridescens viridescens (Rafinesque)

Newts are common in suitable places throughout the valley. For example, they were found to be very abundant in a breeding pool on March 20, 1942. Roger Conant observed them swimming about in the open water and also hiding beneath floating bits of vegetation, including algae. One large male was engaged in eating the eggs of a wood frog. It would seize an egg in its mouth and then tug until the jelly-like covering was pulled loose from the adjacent eggs. The newt ate three eggs in ten minutes and then stopped because it detected the presence of the observer.

Two pairs of newts were observed by Conant on November 28, 1941, as they were going through the mating antics in about a foot of water above the dam at Hart Scout Reservation. They remained clasped when netted and did not separate until handled. On this date there was some ice on the surface of the water.

Ambystoma maculatum (Shaw)

Two egg masses of the spotted salamander were observed in a breeding pool on March 20, 1942. They showed no signs of development, but the external jelly of one was clear and the other cloudy. On April 5, 1942, egg masses were again found in two small pools. On this date several of them had developed sufficiently so that the tails of the embryos were visible within the eggs. The more advanced masses were quite green with algae.

In contrast to the above observation, only breeding adults were observed at the pools on April 2, 1941.

Ambystoma opacum (Gravenhorst)

Diligent collecting may produce more marbled salamanders, a species that is uncommon in southeastern Pennsylvania. The two specimens seen came from the Hart Scout Reservation; one was found as it crossed a road near a small stream.

Desmognathus fuscus fuscus (Rafinesque)

The dusky salamander is very abundant in and along the small streams that drain into the Unami Creek. Twenty-nine specimens have been examined. Individuals vary from light brown to rufous red, and

a few are dark gray, almost black in appearance. Where dorsal pattern is discernible, the frequency of dark pigmented spots is highly variable; in some individuals there is a complete middorsal stripe, a few have scattered dark spots, others are notable for a total absence of spotting. The sides of the body, in most cases, are heavily pigmented with dark brown or black spots. The venters vary from a heavy speckling of small dark spots to an almost immaculate appearance.

The largest specimen is a male with a total length of 105.3 mm., body length 40.2 mm., head length 12 mm., and head width of 10.5 mm.

The smallest fully transformed specimen is 36 mm. in total length.

Plethodon cinereus cinereus (Green)

Both the red-backed and dark color phases of the red-backed salamander are abundant throughout the valley. Many of the individuals collected seemed to show a marked preference for moist or damp habitats, having been found chiefly near small streams and in one instance under logs in a marshy area. A female collected on April 14, 1940, had three well-developed eggs in each oviduct.

Plethodon glutinosus glutinosus (Green)

The six slimy salamanders examined have a consistent pattern variation. The dorsum of all individuals is completely without the usual conspicuous white—or silver—colored spots. These spots are present, however, in a few cases in the ventrolateral region. Small individuals have some spotting on the tail.

In view of the fact that the breeding habits of this salamander are so little known, it is regrettable that detailed notes were not made when members of the Junior Zoological Society of Philadelphia collected *glutinosus* at Hart Scout Reservation on July 4, 1940. They recorded the following information, "One found in a rotten log with several eggs." The specimen was preserved but I have been unable to locate the eggs (if saved) or any further information about them.

A shed skin was found in the stomach of one individual. Evidently the sticky mucus secretions on the skin are not a deterrent to its ingestion although this item is not listed in the stomach contents as recorded or summarized by Bishop (1941).

Hemidactylium scutatum (Schlegel)

The secretive four-toed salamander is represented by one specimen found on July 1, 1940, under a large stone on the side of a hill. The ground was quite wet, offering apparently an ideal habitat.

Pseudotriton ruber ruber (Latreille)

The red salamander has been found both in the small streams and under logs along their banks. Several large adults are sparsely spotted with small dark spots on the dorsum and have an immaculate venter.

Eurycea bislineata bislineata (Green)

In this area, where two-lined salamanders coinhabit the same stream banks with dusky salamanders, *bislineata* outnumbers *fuscus*. All specimens were collected under stones and piles of dead leaves at stream side.

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Bufo terrestris americanus Holbrook

Several American toads were heard calling on April 5, 1942, from rain pools on a ridge overlooking the valley. The specimens examined appear to be typical *americanus,* having at the most two warts in each of the dark dorsal spots and prominent warts on the femur and tibia.

Bufo woodhousei fowleri Hinckley

The only Fowler's toad was collected at Finland, Bucks County. Dorsal dark areas each contain between eight and nine small warts.

Acris gryllus crepitans Baird

The cricket frog has been collected at Hart Scout Reservation.

Pseudacris nigrita feriarum (Baird)

The Unami Valley is one of the few scattered localities near Philadelphia where the eastern chorus frog has not been exterminated. The habitat preference seems to be wet grassy areas and temporary rain pools. Along the ridges and adjacent plateaus they have been found in the rain puddles along plowed fields and other water-filled depressions.

Since there is a marked paucity of data concerning this frog in eastern Pennsylvania, a brief summary of the characters exhibited by fourteen specimens collected on April 5, 1942, is herewith presented. Twelve males have an average snout-vent length of 26.8 mm., range interval 25.2 to 29.0 mm. Tibia lengths average 12.8 mm. and range from 12.2 to 13.7 mm. Two females have snout-vent lengths of 29.8 and 28.7 mm., and tibia lengths of 14.3 and 14.4 mm.

A comparative examination of these specimens with those from the Coastal Plain of eastern Pennsylvania and adjacent New Jersey, shows that they are more robust in body form and are exceedingly variable in dorsal markings. The majority lack the clear-cut striped appearance of the Coastal Plain form; instead their stripes are narrow, sometimes indistinct, and often broken and irregular. The dorsum of a few is irregularly spotted with dark pigment.

On April 24, 1947, two clusters of eggs, attached to single grass stems, were collected. One was found at a depth of six inches and the other at about twelve inches. At the time, the envelopes were breaking so an accurate count of the eggs could not be made. The tadpoles were swimming freely a few hours later.

Hyla crucifer crucifer Wied

Spring peepers are confined primarily to marshy spots in the Valley proper. Very few specimens have been collected or heard calling along the ridges. Voice records indicate that strong choruses were heard at the breeding pools on March 20, 1942.

Rana clamitans Latreille

The green frog appears to be found in any suitable habitat. Collecting records indicate a preference for the smaller tributary streams rather than along Unami Creek.

Rana palustris Le Conte

Cold and sluggish pickerel frogs were observed at Hart Scout Reservation on March 20, 1942. By April 5, several choruses could be heard calling in the Valley. As is the case among the other salientians in this area, they have been found most commonly in or along the small streams that descend from the ridges.

Rana pipiens Schreber

Future collecting may find the leopard frog inhabiting the Valley. To date the nearest localities for *pipiens* have been along the Coastal Plain of eastern Bucks County.

Rana sylvatica sylvatica Le Conte

Roger Conant observed wood frogs at the breeding pools on March 20, 1942. They were all in a very sluggish condition and could be easily caught. Two egg masses, apparently freshly laid, were found and a newt was observed eating the eggs (see above).

Clemmys insculpta (Le Conte)

Wood turtles are relatively common throughout the Valley. One specimen was scooped out of the mud from Unami Creek on June 8, 1941. A large male was caught on a fishing line by Boy Scouts who were using bread as fish-bait. During August I have found *insculpta* both in the woods and open fields of the camp areas.

Clemmys muhlenbergi (Schoepff)

Two specimens of Muhlenberg's turtle have been collected. These turtles are the first records for Montgomery County and I have only one additional record for Bucks County; therefore it should be considered rare in the study area.

Terrapene carolina carolina (Linnaeus)

Box turtles were observed primarily in the heavily wooded camp areas. Ten specimens were observed at Hart Scout Reservation during daily activities in August, 1940. Several of these were seen in the mud along small streams.

Chrysemys picta picta (Schneider)

I have only sight records for the eastern painted turtle occuring in the Unami Creek.

Diadophis punctatus edwardsi (Merrem)

One specimen of the northern ring-neck snake was found at Sumneytown.

Heterodon platyrhinos platyrhinos (Linnaeus)

The valley offers an ideal habitat for the hog-nosed snake even though not many toads have been collected. This snake is seldom encountered in Montgomery and Bucks counties except in the few remaining more or less inaccessible or protected areas.

Coluber constrictor constrictor Linnaeus

The black racer is represented by three specimens. Several individuals I observed along the ridges sought refuge in the loosely piled stones of pasture walls instead of attempting to escape capture by their most usual method of headlong flight.

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Elaphe obsoleta obsoleta (Say)

The pilot blacksnake can be considered relatively abundant in Unami Valley. Three have been preserved. On one occasion I found a snake of this species about to molest a brood of young wood thrushes.

Lampropeltis doliata triangulum (Lacépède)

The upland house snake is frequently encountered and the five specimens examined appear to represent a pure population of *triangulum*. Conant (1943, pl. II) illustrated a specimen from Sumneytown.

Natrix septemvittata (Say)

Unami Creek and its many small feeder streams seem to provide an excellent ecological background for the queen snake. Four adults and a brood of young have been examined. At Camp Delmont, a female 557 mm. in length gave birth to six young on September 9, 1942. One was only partially developed. Their total lengths varied from 149 to 198 mm.

Natrix sipedon sipedon (Linnaeus)

Northern banded water snakes are widely distributed throughout this region. Four have been preserved.

Storeria dekayi dekayi (Holbrook)

De Kay's snake is represented by only one specimen. It is apparently rare in the Valley.

Haldea valeriae valeriae (Baird and Girard)

The first eastern ground snake reported in Pennsylvania (Conant, 1936) was found in the Unami Valley area. Since that time five additional specimens, all from the Hart Scout Reservation have been preserved.

Thamnophis sauritus sauritus (Linnaeus)

The eastern ribbon snakes were all collected during the summer camping season. A female in the Hart Scout Reservation collection gave birth to eleven young during August. Two other adults contained ten and seven partially developed embryos.

Thamnophis sirtalis sirtalis (Linnaeus)

Eastern garter snakes seem to have adapted themselves to almost all ecological habitats in the Valley. Three specimens have been preserved.

Ancistrodon contortrix mokeson (Daudin)

The copperhead is the only poisonous snake in this area. For the safety of the campers, all specimens encountered in the camp areas are killed or collected although no concerted effort is made to exterminate them. I have eighteen records of this snake being found by nature counselors or camp caretakers. On one occasion a copperhead was found swimming across Unami Creek.

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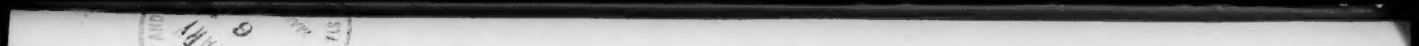
SCIENCE DEPARTMENT, NORTHEAST HIGH SCHOOL,
PHILADELPHIA, PENN.